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EPA Superfund
Record of Decision:

BROWN'S BATTERY BREAKING
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Text:
RECORD OF DECISION

BROWN'S BATTERY BREAKING SITE

DECLARATION

SITE NAME AND LOCATION

Brown's Battery Breaking Site
Tilden Township, Pennsylvania
Operable Unit II - Remediation of Site Soils and Ground Water

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Brown's Battery Breaking Site ("the Site"), located in Tilden Township, Berks County, Pennsylvania. The remedial action was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this Site.

The Commonwealth of Pennsylvania has not concurred in this remedy.

ASSESSMENT OF THE SITE

Pursuant to duly delegated authority, I hereby determine pursuant to Section 106 of CERCLA, 42 U.S.C. S9606, that actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to the public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The overall cleanup strategy for the Site consists of two Operable Units: Operable Unit I, presently being implemented, which addressed restriction of Site access and relocation of the Site residents and the onsite business, and this second Operable Unit which will address the contaminated soils and ground water. Specifically, the selected remedy for Operable Unit II, Remediation of Site Soils and Ground Water, will remove contamination from onsite soils so that the Site can be used in an industrial manner, and will restore the ground water to its beneficial use by cleaning both the shallow and deep aquifers to background levels. A contingent soil remedy, to be implemented if the selected soil remedy is not implementable, also has been chosen and will accomplish the same remedial goals. This Operable Unit II is the final action of two Operable Units for the Site.

The major components of the selected remedy include:

- Offsite treatment of soil and battery casings using an innovative thermal treatment technology. EPA also has selected a contingent soil alternative of onsite solidification/ stabilization of the soils and casings and offsite disposal should the innovative technology not prove implementable;

- Construction of a vertical limestone barrier in the shallow aquifer; and

- Pumping of the bedrock aquifer with onsite treatment and disposal.

STATUTORY DETERMINATIONS

Both the selected remedy and the contingent remedy are protective of human health and the environment and are cost effective. EPA believes that both remedies will comply with all Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action with the sole exception of the Commonwealth of Pennsylvania's requirements for closure of hazardous waste disposal sites. Therefore, in accordance with 40 CFR S300.430(e)(9)(B), I hereby waive the provisions of 25 PA Code S265.300-310 on the basis that EPA will achieve an Equivalent Standard of Performance in the protection of human health and the environment by the implementation of either the selected remedy or the contingent remedy. Both remedies utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable and satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review by EPA will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

RECORD OF DECISION
BROWN'S BATTERY BREAKING SUPERFUND SITE
TABLE OF CONTENTS

THE DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The Brown's Battery Breaking Site (Site) is located in Tilden Township, Berks County, Pennsylvania at latitude 40 degree 31' 15" N and longitude 76 degree 00' 06" W. The Site is approximately 14 acres in size and is located approximately two miles northwest of Shoemakersville, Pennsylvania (Figure 1). The 1990 population of Shoemakersville was 1,410 people.

The Site is bordered by Reading, Blue Mountain and Northern Railroad tracks to the northwest, Fisher Dam Road to the northeast, the Schuylkill River to the southeast, and Mill Creek to the southwest (Figure 2).

The land use in Berks County is agriculturally oriented with scattered rural residences on a wide variety of lot sizes. The Site is in the vicinity of the largest concentration of farmland in the county. Pockets of commercial development exist in Shoemakersville to meet the needs of the rural community. The county's industrial land use tends to be concentrated in the urban areas and along major roadways and rail lines.

Tilden Township is in the foothills of Blue Mountain which includes the Hawk Mountain Sanctuary and Pinnacle Peak Conservation area to the east of the Site. The Schuylkill River is designated a State scenic river and in Tilden Township it is used for recreation, including swimming, small boat launching and summer riverfront cottages.

Conservation groups in the region include the Schuylkill River Greenways Association and the Berks County Conservancy. Both groups are seeking conservation easements along the Schuylkill River and the railroad that follows its banks. The Berks County Conservancy owns a 35-acre easement just north of the Site.

Site area topography is relatively flat with the exception of two manmade features. The railroad berm rises 9 feet above the Site and there is an area elevated 6 to 8 feet above the surface in the southwest corner of the Site known as the "containment area". Approximately 50% of the Site is located in the 10-year floodplain. The entire Site, except for the central portion of the containment area, lies within the 100-year floodplain.

Currently, a one-story brick home, a mobile home, a log cabin residence, and an automobile and truck service shop are located on the Site (Figure 2). Although the log cabin residence was constructed prior to 1860, EPA believes it has little or no historic significance because of modifications made to it by past and present owners.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. BACKGROUND

From 1961 to 1971, Mr. Robert Brown conducted a battery recycling/lead recovery process at the Site. Batteries were brought to a building ("the breaking building"), they were placed on their sides upon a conveyer belt and carried to a hydraulic guillotine. The guillotine sliced the top from each battery casing, allowing access to the lead alloy grids. In the early years of Mr. Brown's operation, the open-top batteries were manually inverted and the sulfuric acid was poured directly onto the ground outside the breaking building, along with the battery grids. The empty battery casings were deposited on the ground surface to the west side of the breaking building and in several pits located along Mill Creek and the railroad tracks. Battery grids were loaded onto a trailer for transport and resale. The foundation of the breaking building still exists onsite.

From 1965 to 1971, the battery casings were rinsed with water prior to disposal to remove any residual lead oxides remaining in the casings. The rinse water was collected in steel tanks together with the insoluble lead oxide. At the end of each working day the insoluble lead oxide was recovered and shoveled into the trailer containing the battery grids. The rinse water was then poured directly onto the ground outside the breaking building. The casings were crushed after rinsing and the smaller battery casing pieces were sometimes used as a substitute for road and driveway gravel around the Site and for several local properties, including farms and at least one housing development. Otherwise, the battery casing pieces remained onsite.

During the ten years of facility operations from 1961 to 1971, battery casings were deposited over much of the Site. The total number of batteries processed on the Site is unknown. Operations at the Brown's Battery Breaking Site ceased in 1971, following the sudden death of Mr. Brown, and ownership of the property passed to his wife, Barbara Brown. Currently, most of the northern portion of the Site is owned by Mrs. Susan and Mr. Terry Shaner, Sr., and most of the southern portion is owned by Mr. Terry Shaner, Jr. Mr. Richard Strausser owns the parcel of land in the northeast portion of the Site consisting of the log cabin and approximately three quarters of an acre of surrounding property. (Figure 2). The Reading, Blue Mountain, and Northern Railroad owns a strip of land, which includes the railroad tracks, along the entire northwest side of the Site.

In March 1980, the Pennsylvania Department of Environmental Resources (DER) was requested by the farm owner to examine the cattle and water supplies at a dairy farm near the Site, in Shoemakersville, Pennsylvania. Tests on the cattle and farm-pond water indicated elevated lead levels. Further investigation revealed the use of broken battery casings as the driveway materials at the farm. The farmer identified a nearby property on Fisher Dam Road, formerly owned by Robert Brown, as the supplier of the battery casings. This property later became known as the Brown's Battery Breaking Superfund Site.

In June 1983, the Pennsylvania Department of Health (DOH) tested the blood of the four young children who, at the time, resided on the Site. The blood tests for all four children revealed lead concentrations in excess of the 30 micrograms per deciliter (ug/dl) health action limit established by the Centers for Disease Control (CDC). DOH subsequently instructed parents on proper cleaning procedures and limiting the children's activities in contaminated areas.

A Preliminary Assessment (PA) was conducted by EPA in 1983. Based on the PA results, the EPA On-Scene Coordinator (OSC) determined that a detailed Extent of Contamination (EOC) survey was required. The EPA Environmental Response Team (ERT) was tasked to design a multimedia survey that would address the areas of concern identified during the PA. The survey had the following objectives:

- Determine the areal and vertical extent of contamination, including battery casings, soils, and sediments;

- Determine the total quantity of waste materials present and identify deposits of potentially recoverable lead; and,

- Determine the potential for transport of lead from the Site by surface water, ground water, and air.

ERT conducted the field sampling program for the EOC survey between November 1-3, 1983. Samples were collected from soil, air, vegetables grown in two onsite gardens, two onsite drinking-water wells, Schuylkill River and Mill Creek surface waters and sediments, ponded water on the Site, and battery casing piles on the Site. In addition, battery casing depths were recorded along an established sampling grid, and sampling points were surveyed. A rapid turnaround Feasibility Study (FS) report was completed during this same time period. The purpose of the report was to evaluate methods of hazard mitigation.

The EOC survey report was completed in December 1983, and concluded that capping addressed the immediate threat to the public health by preventing direct contact with lead-bearing soils and dust by people living or working on the Site.

A Site Investigation (SI) was completed in 1984. The SI established extensive lead contamination in onsite soils and in sediments located in the Schuylkill River.

B. FIRST REMOVAL ACTION

A CERCLA Immediate Removal Request was forwarded from EPA Region III to EPA Headquarters on October 6, 1983, for temporary relocation of the onsite residents, performance of studies to select a removal cleanup option, provision of Site security, decontamination of residences and related tasks. Approval was received on October 20, 1983, and the three families residing on the Site were relocated on October 31, 1983, for the duration of the onsite construction activities. Based on the results of the above studies, excavation of the contaminated soils and battery casings began on January 9, 1984 and continued until June 13, 1984. Soils and battery casings were placed in the southwest section of the Site and covered with a low-permeability soil cap. This area is referred to as the "containment area."

The quantity of excavated battery casings and soil materials moved into the containment area during the removal action was reported by the OSC to be approximately 13,000 cubic yards. Nearly 20,000 cubic yards of clean fill was used to regrade the excavated areas, primarily on the northeast, the southeast, the area between the railroad tracks and containment area, and central portions of the property. The containment area was capped with over 6,000 cubic yards of low-permeability soil. The resulting containment area measured 600 feet by 230 feet and was 6 to 8 feet high. The total cost of the removal and containment was approximately 1.4 million dollars. The removal action was completed on July 11, 1984, and the three relocated families returned to their residences.

C. INCLUSION OF THE NATIONAL PRIORITIES LIST

The Brown's Battery Breaking Site was proposed for inclusion on the Superfund National Priorities List (NPL) in October, 1984. The Site was placed on the NPL in June, 1986 (51 FR 21054).

D. SECOND REMOVAL ACTION

As a result of the Remedial Investigation/Feasibility Study (RI/FS) sampling activities conducted by EPA between June, 1989 and March, 1990, a second removal action was determined by EPA to be necessary at the Site. This decision was based on a toxicological review of surface soil sampling results which found elevated lead concentrations on the property of current residents and in areas immediately adjacent to their homes. At that time, seven adults and two children lived onsite in the four residences.

The second removal action was initiated in June 1990 and provided, once again, for temporary relocation of all onsite residents to suitable offsite locations. This action did not address the onsite business activities. One family was relocated under this second removal.

E. RECORD OF DECISION FOR OPERABLE UNIT ONE

On September 28, 1990, the EPA signed a Record of Decision authorizing the permanent relocation of all the residents and the automobile and truck service shop, the construction of a fence around the Site, and the placement of deed restrictions on the property. Implementation of this ROD is presently underway.

F. HISTORY OF CERCLA ENFORCEMENT ACTIVITIES

Between October 24 and 26, 1983, General Battery Corporation (GBC) and the Site owner were verbally notified by EPA of EPA's intent to conduct removal activities at the Site and were offered the opportunity to perform such activities. A follow-up letter by EPA on November 17, 1983, to both parties stated that, since neither the Site owner nor GBC had notified EPA of their willingness to undertake the removal activities, EPA would begin such activities. On March 2, 1983, EPA issued a unilateral administrative to GBC, pursuant to Section 106 of CERCLA, to undertake the removal activities. That order was withdrawn on March 30, 1984.

On June 30, 1987, GBC entered into an Administrative Order On Consent to perform the RI/FS for the Brown's Battery Breaking Site. However, EPA later determined that performance of studies in addition to those specified in the Order, including additional air and stream sampling as well as installation and sampling of additional monitoring wells, was necessary in order to complete the RI/FS. GBC, on August 4, 1988, formally notified EPA that GBC was "unwilling to proceed with the performance of the RI/FS, as modified by the EPA". On August 25, 1988, the Regional Administrator notified GBC that EPA would take over the RI/FS and release GBC from all obligations under the June 30, 1987 Consent Order, except for the obligation to pay any stipulated penalties and accrued oversight costs.

In March of 1985, the United States brought a civil action, pursuant to Sections 104 and 107 of CERCLA, 42 U.S.C. SS9604 and 9607, against GBC and Terry Shaner, the Site owner. In the action, the United States sought its past costs for the 1983-84 removal action and for all subsequent costs associated with the response work at the Site. This litigation is still ongoing.

On July 27, 1990, EPA issued a Unilateral Order pursuant to Section 106(a) of CERCLA, 42 U.S.C. S9606(a), to

GBC and the present Site owner, to perform additional removal work at the Site. The order required GBC and the Site owner either to temporarily relocate those onsite residents desiring such relocation or excavate contaminated surface soils and relocate affected residents during the excavation. The respondents have not complied with this order.

On April 1, 1991, issued a Unilateral Order to the present Site owners to, among other things, provide EPA access to the Site for performance of certain studies and the relocation of site residents, and to refrain from leasing or permitting anyone to live on the Site once residents were relocated. EPA is assessing the respondents' compliance with this Order.

G. HIGHLIGHTS OF COMMUNITY PARTICIPATION

All public participation requirements of Sections 113(k)(2)(B)(i-v) and 117 of CERCLA have been met in this remedy selection process. A onequarter page newspaper advertisement was published in the Reading Times/Reading Eagle, Reading, Pennsylvania, on January 8, 1992. It specified the availability of the Proposed Remedial Action Plan (PRAP), the duration of the public comment period, and the location of the Administrative Record.

The public comment period on the PRAP began on January 8, 1992, and ended on March 9, 1992, having been extended an extra 30 days based on a timely request from the public. A public meeting to discuss the PRAP was held on January 21, 1992, at the Hamburg Borough Hall. Approximately 300 people attended, including former and current Site residents, the current Site owner, supervisors from Hamburg Borough, staff from EPA Region III and DER as well as several hundred employees of General Battery Corporation.

Based on public comments received during that comment period, EPA issued a revised PRAP. EPA published a new one-quarter page newspaper advertisement in the Reading Times/Reading Eagle on April 14, 1992, announcing the revised PRAP and new 30-day comment period ending May 15, 1992. This announcement also offered the opportunity for a public meeting if the public desired one. No public meeting was requested and none was held.

III. SCOPE AND ROLE OF OPERABLE UNIT TWO WITHIN SITE STRATEGY

The overall Site cleanup strategy consists of two Operable Units: Operable Unit One which requires the restriction of Site access and relocation of onsite residents; and Operable Unit Two which requires the remediation of onsite soils, battery casings and ground water. This Record of Decision addresses Operable Unit Two, remediation of soils, casings and ground water.

The RI/FS documented extensive lead contamination of onsite soils. It also documented the release of contamination into adjacent surface water and sediments and into the ground water of the shallow and bedrock aquifers. Direct contact with the contaminated soils and potential ingestion of contaminated ground water pose the principal risks at this Site. A full description of the results of the investigation appears in the "Summary of Site Characteristics" section, immediately below.

IV. SUMMARY OF SITE CHARACTERISTICS

A. BACKGROUND

The field work for the Remedial Investigation/Feasibility Study (RI/FS) was performed in four phases. The activities and dates for each phase are as follows:

- Phase I was conducted in June, 1989, and consisted of soil sample collection, surface water and sediment sample collection,and ground water sample collection from two potable wells on the Site.

- Phase II occurred during the fall and winter of 1989. Phase II included the collection of additional soil samples, the installation and sampling of four overburden monitoring wells, and the sampling of three existing overburden monitoring wells. Additional Phase II soil samples and treatability study samples were collected during March, 1990.

- Phase III was undertaken in the spring of 1991. Four overburden monitoring wells were installed. Ground water samples were collected from all but one of the existing wells. In addition, samples of settled dust, paint, and surface soils were collected.

- Phase IV was conducted in July and August of 1991 and consisted of the installation and sampling of three bedrock wells.

Air was not extensively sampled during the RI, but the potential for contaminant migration via the air pathway was evaluated using the Industrial Source Complex (ISC) model.

Soil is by far the most contaminated medium onsite. Lead is the most abundant, widespread, and concentrated contaminant present. Low concentrations of other metals and Target Compound List (TCL) organic contaminants were also sporadically detected in soils and other media, but these contaminants are relatively minor and do not pose significant risk to public health or the environment nor require any remedial action. Therefore, the following discussion on the nature and extent of Site contamination focuses on the occurrence of lead.

Site soils and associated lead-bearing wastes (battery components) are the primary sources of lead occurring in all other environmental media. Another source of lead in Site soils was battery acid drained onto the soils in the vicinity of the battery breaking building. Relatively high lead concentrations were detected in this area, but due to the presence of abundant battery casings in subsurface soils, the relative contribution of battery acid is undetermined.

Most of the crushed battery casings and associated lead contaminated soils were consolidated in the containment area and capped during the initial removal action. However, some contaminated soils were left in place and covered by backfill materials after battery casing/soil removal. Vertical distribution of lead in the soil column is not consistent throughout the Site and does not always display a simple pattern of high surficial concentrations that decrease with depth. In some areas, surficial soils are relatively clean whereas underlying soils are contaminated.

B. SOILS

The results of Site sample analyses indicate that soils are the most heavily impacted environmental medium at the Site and lead is the contaminant of concern. Although organic compounds including PAHs, phthalate esters, chlorinated pesticides, and PCBs were also detected, they were not widespread at the Site and were present only in extremely low concentrations which present no threat to human health or the environment.

Soils data indicate widespread lead contamination in surficial soils. Most areas of the Site had lead in surficial soils exceeding the cleanup goal of 1000 ppm. The most highly contaminated soils were concentrated in the general area between the containment area and the service shop, in the area just southwest of the mobile home residence adjacent to the Schuylkill River, and in the wooded area between the containment area and Schuylkill River.

EPA sampling data show that concentrations of lead in soil range from background to 60,000 ppm. Still higher concentrations, up to 170,000 ppm,were indicated by the ERT Atomic Adsorption (AA) lead analysis. However surficial concentrations were generally below a few thousand ppm.

The occurrence of lead concentrations greater than a few thousand ppm in the shallow subsurface was sporadic. In general, these occurrences correlated well with the occurrence of battery casing fragments.

C. SHALLOW AQUIFER

Aluminum, iron, and manganese were among those contaminants detected in elevated concentrations in filtered ground water samples collected from Site monitoring wells during Phases II and III. In addition, low concentrations of lead, zinc, and copper were detected in one out of three unfiltered ground water samples collected from the log residence domestic well during Phase II. The results of Phase II and III sampling indicate that similar concentrations of calcium, magnesium, and sodium were present in the log residence well during both phases. No other metals were detected in unfiltered ground water samples collected from this well during either phase.

Low concentrations of methylene chloride, acetone toluene, and methoxychlor were detected in ground water collected during Phase III; however, these compounds were not detected substantially above the level reported in laboratory or field blanks, or the concentration was below the detection limit and is not accurate or precise. In addition, ground water samples collected during Phase II efforts did not contain any volatiles, semi-volatiles, or pesticides/PCBs.

Several dissolved metals were detected in overburden monitoring well samples in concentrations above background levels during Phase II and Phase III. These metals include lead, aluminum, cobalt, iron, manganese, nickel and zinc. While lead and zinc are components of battery wastes, the other metals are apparently naturally occurring. The presence of elevated concentrations of dissolved metals from both waste sources and naturally-occurring sources is the result of battery acid dumping which has reduced the ground water ph and allowed for the dissolution of these metals.

Ground water samples from all overburden monitoring wells had pH levels below the background range of pH 6.7-6.6. With one exception, the overburden wells with the lowest pH levels also contained the highest concentrations of dissolved metals. Three of these wells are located near and downgradient of the battery breaking building. Past battery acid disposal is interpreted to be responsible for the low pH readings in this area of the Site. The fourth well is located at the end of the containment area near Mill Creek. It is possible that the low pH in this well is due to the residual sulfuric acid in the lead contaminated battery casings and soil aggregated in the containment area. It should be noted, however, that this well did not contain detectable amounts of lead (total or dissolved fraction) during either sampling phase. The dissolved metals present in elevated concentrations in these five overburden wells were aluminum, lead, cobalt, manganese, nickel and zinc.

Dissolved lead was detected in three monitoring wells sampled during Phase III in concentrations between 13 ppb and 55 ppb. Cobalt was detected in four Phase II monitoring wells in concentrations ranging from 74.3 ppb to 177 ppb (dissolved metals), but in only one well during Phase III (225 ppb total metals).

Dissolved manganese was detected in all Site monitoring wells at levels exceeding background concentrations during Phase III. The highest concentration was 30,600 ppb and the lowest 1900 ppb.

Like cobalt, the dissolved nickel concentrations decreased from Phase II to Phase III. During Phase III nickel was found in roughly equal concentrations ranging from 31.7 to 65.4 ppb.

The dissolved zinc concentrations in the filtered samples obtained ranged from 229-240 ppb in Phase III. Like nickel, the dissolved zinc concentrations were detected during Phase III at lower concentrations than in Phase II.

The decreasing concentrations of these dissolved metals, including manganese, from Phase II to Phase III is probably a seasonal effect. Samples collected during Phase III generally had higher pH than Phase II samples. The Phase II sampling event (November, 1989) was preceded by a dry season, whereas during Phase III (April, 1991), the ground water obtained more recharge. As a result, higher concentrations of hydrogen ions (lower pH) and dissolved metals were observed during Phase II when less precipitation and, therefore, less dilution occurred.

Sulfate concentrations, sulfide concentrations and alkalinity were measured exclusively during Phase III in all monitoring wells except one which did not contain sufficient volume of water for collection of samples for ion analysis. Sulfate results indicate that the highest sulfate concentrations are associated with low pH values. This clearly indicates the extent of overburden aquifer contamination by sulfuric acid (consisting of sulfate and hydrogen ions) on the Site.

Alkalinity values ranged from non-detected to 101 mg/L in overburden wells.

D. BEDROCK AQUIFER

The concentrations of most metals in the bedrock aquifer are considerably higher than in the overburden aquifer, reflecting dissolution of large quantities of solids. Dissolved cadmium is high in the well nearest the battery breaking building (58 ppb and 26 ppb during EPA sampling on August 2, 1991 and August 14, 1991, respectively). Farther downgradient, the dissolved concentration decreased by approximately 30%. The dissolved cadmium in the bedrock aquifer is probably the result of dissolution by battery acid. No cadmium was detected upgradient of the battery breaking building. Sulfate occurrence in the bedrock aquifer is a direct result of acid dumping during the battery breaking operations. Sulfate concentration ranges from 27 ppm to 4910 ppm.

Dissolved lead concentrations vary consistently with cadmium and sulfate concentrations in three bedrock wells. The lead concentration ranges between Non-Detectable and 14.6 ppb.

The high concentrations of all dissolved metals such as beryllium, manganese and nickel vary similarly among bedrock wells with high concentrations near the battery breaking building and low background concentrations near the upgradient well. This trend is consistent with both major aquifer constituents and trace aquifer constituents. The primary cause for this trend is the sulfuric acid near the battery breaking building.

The concentrations of dissolved metals in the bedrock aquifer are generally much higher than those in the overburden aquifer. This is likely because precipitation has percolated into the overburden aquifer and replaced the water with high concentrations of dissolved metals. Meanwhile, the high metal concentrations in the bedrock aquifer remain largely undiluted.

Low concentrations of dissolved and suspended metals including lead, zinc, iron, and manganese were detected in surface water samples obtained from Mill Creek and the Schuylkill River adjacent to the Site. Suspended metals are probably contributed by runoff and dissolved metals by ground water discharge from the Site. Analysis of downstream water samples did not reveal elevated concentrations of dissolved or suspended metals. Therefore, the low concentrations of metals in surface water must attenuate quickly by methods such as dilution, sorption, and coprecipitation.

Sediment samples obtained from the Schuylkill River upstream of the Site contained lead concentrations up to 259 ppm that are considered above background levels. Sediment samples obtained from the Schuylkill Riverdirectly adjacent to the Site contained concentrations of lead greater than background levels, and in some cases greater than upstream sediment lead concentrations. Sediment samples obtained from the Schuylkill River downstream of the Site did not contain concentrations of lead greater than upstream samples.

E. AIR

Onsite soils contaminated with lead have the potential to be suspended and transported by wind erosion and vehicular traffic as particulate emissions or dust. This contaminated dust can then be ingested or inhaled by persons on or near the Site.

Particulate emissions were evaluated using the ISC Model and through limited ambient air sampling for lead. The modeled results for ambient particulate emission impact were multiplied by the mean lead concentration in the driveway material to arrive at ambient lead impact concentrations.

The maximum particulate emissions and lead impact occurred at a location approximately 35 meters north-northeast of the log cabin residence onsite. The estimated quarterly average lead impact concentration at this location is 0.0041 ug/m[3]. This concentration is 0.3 percent of the National Ambient Air Quality Standard ("NAAQS") for lead of 0.15 mg/m[3], time weighted average (TWA). No ambient samples exceeded the NAAQS for lead.

Due to the lack of standard methods for sample collection and analysis of settled dust samples, the lead values were evaluated qualitatively rather than quantitatively. While no federal or Pennsylvania standards currently exist for regulating lead in household settled dust, the States of Maryland and Massachusetts have established standards ranging from 200 ug/ft to 800 ug/ft. Samples collected in the brick residence did not exceed these lead standards. The lead results for the brick residence ranged from 6.21 ug/ft to 56.88 ug/ft.

F. VOLUME OF CONTAMINATED SOIL OUTSIDE THE CONTAINMENT AREA

Using the cleanup level of 1000 ppm, as discussed in Section VI below, the volume of soil and battery casings outside the containment area requiring excavation is estimated to be 27,500 cubic yards.

G. VOLUME OF CONTAMINATED SOIL/BATTERY CASINGS WITHIN THE CONTAINMENT AREA

Two test pits were excavated within the containment area to obtain samples for the two treatability studies. Based on a visual estimate, the excavations indicate that the material in the containment area is approximately 70 percent crushed battery casings. The total volume of waste materials in the containment area is estimated at 39,500 cubic yards. This estimate is based on cross-sections and as-built drawings prepared during the initial removal action, and the assumption that all materials placed in the containment area were contaminated.

V. CONTAMINANT FATE AND TRANSPORT

Lead is the most widespread and concentrated contaminant present on the Site and was identified as the contaminant of greatest health concern on the Site based on the baseline risk assessment.

Current information about the Brown's Battery Breaking Site indicates that three migration pathways are significant: air, ground water, and surface water. Data collected during the RI indicate that offsite migration occurs to the surface water and ground water pathways. Current data on the bedrock ground water pathway is limited due to the limited scope of the hydrogeologic investigation. An expanded hydrogeologic evaluation of the bedrock ground water will need to be performed during the design of the Remedial Action.

A. CONTAMINANT PERSISTENCE

Lead is not usually mobile in ground water or surface water because solubilized lead, leached from ores or other sources, is adsorbed by ferric hydroxide or tends to combine with carbonate or sulfate ions to form nearly insoluble compounds. The equilibrium solubility of lead compounds in water is low. Therefore, filtered ground water or surface waters within environmental ranges of pH would not normally contain detectable amounts of lead.

In addition to the formation of salts or hydroxides, lead is preferentially adsorbed to organic acids, particularly humic and fulvic acids. Humic and fulvic acids are the decay products of organic matter containing cellulose. These organic acids are resistant to further decay and possess high cation exchange capacities. Organic acids are present in soils, sediments and to some extent, are suspended in surface waters.

Sorption is the primary mechanism for reducing soluble lead in natural waters, soils and sediments. Therefore, the mobility of lead in the environment is restricted to co-transport on organic or inorganic materials or transport as insoluble lead particles. Lead may also be present as colloidal particles that are capable of passing a 0.45 micron filter.

B. CONTAMINANT DEPOSITION AND MIGRATION PATHWAYS

The battery breaking activities performed on the Site over a ten year period contributed lead sulfates, lead oxides, particles of lead alloy, and substantial amounts of sulfuric acid to the Site. These activities were centrally located on the Site at the battery breaking building. In addition to the deposition of acid on the ground surface, contaminated broken battery casings were spread over much of the surface of the Site. Casings were used as a base material for the driveway extending from Fisher Dam Road to the service shop, and were placed in several pits as deep as 10 feet below the surface of the ground in areas near Mill Creek and along the railroad line.

RI sample results establish the presence of lead on the Site in Site soils, sediments, unfiltered surface water samples in Mill Creek and the Schuylkill River, and in both filtered and unfiltered ground water samples.

The vertical distribution of lead at concentrations greater than 1000 ppm was generally limited to the upper four feet of the soil column. Significant exceptions to this generalization include the containment area (where lead-bearing wastes were observed at depths up to ten feet during the first Removal Action), an area near the brick house, and the narrow strip of land between the containment area and the railroad tracks (Figure 3).

Migration pathways established as a result of the current understanding of the nature and extent of contamination found on the Site are as follows:

Air Pathway: Wind or vehicular traffic resuspension and transport of soils into surface waters adjacent to the Site and around the surface of the Site.

Ground Water: Vertical and horizontal migration of lead-bearing particles
in Pathway soil pores, along root channels, and by resolubilization;

Movement of ground water into surface waters or into potable wells onsite.

Surface Water: Surface movement of soil via runoff caused by precipitation
Pathway (rainfall, snowmelt) into the Schuylkill River and Mill
Creek;

Sediment movement in the Schuylkill River and Mill Creek.

Evaluation of the air pathway was accomplished through the use of the ISC model. The model predicts that low concentrations of lead-bearing particulate matter can become airborne through wind erosion and disturbances caused by vehicular traffic. The model further predicts that virtually no lead-bearing particulate will migrate beyond the Site boundary.

Ground water results indicate that several metals have become solubilized and mobilized in Site ground water due to onsite battery acid dumping which has depressed ground water pH. Solubility of metals generally increases as pH decreases. The depressed pH in the shallow ground water has mobilized metals including lead and zinc, both of which are battery waste components. In addition, it has mobilized iron, manganese, nickel, aluminum, and cobalt which occur naturally onsite (Figure 4). Evaluation of Site hydrogeology indicates that ground water

contaminated by soluble metals is in hydraulic communication with the bedrock aquifer. In addition, ground water will discharge to adjacent surface water bodies to some extent.

Ground water in the bedrock aquifer contains very high levels of sulfate and dissolved solids (manganese, calcium and magnesium) immediately downgradient of the battery breaking building. There is also an elevated concentration of cadmium in these wells. The pH in the wells downgradient of the battery breaking building was also lowered to levels between 4 and 5. The sulfate, dissolved solids and cadmium all appear to be the result of the battery breaking operation because levels upgradient were very low or undetected and representative of background (Figure 5). Surface water sampling and analysis detected low concentrations of suspended and dissolved lead, zinc, and manganese adjacent to the Site. Downstream surface water samples did not contain elevated metals concentrations. Therefore, EPA has concluded that metals in solution are quickly attenuated by dilution, sorption to sediments, and/or precipitation.

Sediment samples generally did not exhibit elevated metals concentrations except for those samples obtained directly adjacent to the Site, which contained up to 367 ppm lead. The Schuylkill River channel in the Site area is apparently not an area of sediment deposition. Metals accumulating in sediments are probably periodically scoured by flooding, then diluted and re -deposited downstream.

C. POPULATION AND ENVIRONMENTAL AREAS POTENTIALLY AFFECTED

Prior to 1990, four residences and an active automobile and truck service shop existed onsite. A total of seven adults and two children resided in the four residences. Two of the residents were employed at the auto shop. Two additional adults reside offsite but are employed at the shop. A second removal action was initiated on June 29, 1990, the purpose of which was to provide temporary relocation to the residents to protect them from direct exposure to onsite contamination. The occupants of one residence agreed to be moved under this action. Two residents and their mobile home trailer as well as the residents of the log cabin have been relocated under the ROD for Operable Unit I. Further relocation activities are planned for the near future. Access to the Site is currently unrestricted, thereby allowing an undetermined number of people direct exposure to onsite contamination via the various pathways described above.

In addition to the direct exposure to the high levels of contamination present in onsite soils and to a lesser extent in ground water, the RI documented the release of contamination into the surface water and sediments of the Schuylkill River. The Schuylkill River borders the entire southern property line of the Site and is classified as a recreational river. The river is a primary drinking source for several cities located downriver of the Site. Several downstream industries also utilize the river as a water resource.

Mill Creek is located along the western bank of the Site property and flows directly into the Schuylkill River at the southwestern corner of the property. It is stocked with trout at a location approximately one mile above the Site. DER officials estimate that trout could migrate into the area of Mill Creek adjacent to the Site. In addition to the stocked trout, there are numerous indigenous species of aquatic wildlife in both Mill Creek and the Schuylkill River. Typical terrestrial woodland wildlife inhabit the Site year round and various migratory birds may feed or nest at the Site for relatively short periods of time.

VI. SUMMARY OF SITE RISKS

During the RI/FS, an assessment was made to estimate the health and environmental impacts from exposure to the contaminated soil, battery wastes, and ground water as a drinking water source at the Brown's Battery Breaking Site. This assessment is commonly referred to as a baseline risk assessment. This assessment focused on the health effects that could result from the following exposure pathways:

- Ingestion of contaminated soil and settled house dust by a resident child and adult.

- Ingestion of contaminated fish caught in the Schuylkill River by a resident child or adult.

- Ingestion of contaminated water by a resident child swimming in the Schuylkill River.

- Ingestion of contaminated drinking water by a resident child or adult.

- Inhalation of contaminated respirable dust by a resident child or adult.

The baseline risk assessment focused on lead, manganese, nickel, beryllium and cadmium as contaminants of concern. These metals are relatively insoluble and are not mobile in the environment under normal conditions. These metals tend to adhere strongly to soil particles and remain near the area of deposition. They do not readily migrate in ground water under natural conditions; however, the dumping of battery acid onsite has lowered the ground water pH thus increasing the solubility of several metals and the likelihood that they will migrate in groundwater.

A. TOXICITY ASSESSMENT

1. Lead

Exposure to lead via inhalation and ingestion can cause potential carcinogenic and noncarcinogenic adverse health effects. The following sections present toxicological information and toxicity values for the carcinogenic and noncarcinogenic effects of lead.

Carcinogen Effects. The Carcinogenic Assessment Group (CAG) of the U.S. EPA has recently assigned a weight-of-evidence classification of B2 to lead, indicating that lead is a probable human carcinogen. The B2 classification was assigned on the basis of sufficient animal evidence, with inadequate human evidence.

Noncarcinogenic Effects. The noncarcinogenic toxicologic effects of lead are well documented. Lead affects the following human systems or organs:

- Hematopoietic system
- Nervous system
- Kidneys
- Gastrointestinal system
- Bone marrow cells
- Reproductive system
- Endocrine system
- Heart
- Immune system

The consensus on the blood lead (Pb-B) level of children which is considered toxic has changed in recent years. In 1975, the U.S. CDC defined the toxic level in children's blood as 40 ug/dl. This value was reduced in 1985 by CDC to 25 ug/dl. In 1986, the World Health Organization (WHO) recommended 20 ug/dl as the upper acceptable toxic limit for children. In the same year, EPA's Clean Air Scientific Advisory Committee indicated that levels of 10 to 15 ug/dL can be associated with adverse health effects in children. In October, 1991, the U.S. CDC recommended an intervention level of 10 ug/dl.

Consequently, a Pb-B level of 10 ug/dL was used as the Pb-B limit for children, below which children should not be considered at risk from exposure to lead, according to currently available data.

For adults, particularly white males of 40 to 59 years old, studies have indicated that increases in blood pressure are associated with Pb-B levels ranging from possibly as low as 7 ug/dL to 30 - 40 ug/dL. As a result, a Pb -B level limit of 10 ug/dL was used for adults, below which adults should not be considered at risk from exposure to lead.

2. Manganese

Manganese (Mn) is an essential element for humans (i.e., required for proper functioning of the human body), and is also used in making steel alloys, dry -cell batteries, electrical cores, ceramics, matches, glass, dyes, in fertilizers, welding rods, as oxidizing agents and as animal food additives. Inhalation exposure to high concentrations of manganese dioxide can result in lung inflammation, whereas chronic inhalation exposure results in damage to the central nervous system similar to Parkinson's disease, as well as cirrhosis of the liver. The estimated safe daily intakes Mn for lifetime exposure is an oral dosage of $1x10^{-1}$ mg/kg/day (RfD), and an inhaled dosage of $1.1x10^{-4}$ mg/kg/day (RfC).

3. Nickel

Nickel (Ni) is an important element used for electroplating coatings for turbine blades, helicopter rotors, extrusion dies coinage, ceramics, storage vessels, batteries, and electronic circuits as well as in the production of steel and many other alloys. The major source of human exposure is in the workplace by inhalation of dust and fumes and skin contact, but it can also affect the general populations by ingestion of contaminated food stuffs and drinking water, usually in the form of soluble salts. It has been known for over 40 years that inhalation of nickel is associated with the development of lung, nasal and respiratory cancer. However, an evaluation of the carcinogenicity of soluble salts of nickel, which are possible contaminants of soil, water, and food, has not been performed.

Noncarcinogenic effects of nickel exposure include nausea, fever, lung inflammation and respiratory failure following acute incidences, as well as contact dermatitis (skin rashes). There is also evidence that chronic ingestion of nickel containing foods increases the risk of developing skin rashes. Studies performed in animals to estimate the long-term effects of nickel exposure showed a decrease in body and organ weights of rats (may be indicative of disease), as well as a decrease in their appetite. The estimated safe oral dosage (RfD) for lifetime exposure to Ni is $2x10^{-2}$ mg/kg/day.

4. Beryllium

Beryllium (Be) is a highly toxic heavy metal (also occurring as Beryllium salts) resulting from coal combustion and other industrial processes. The principal routes of human exposure are inhalation, ingestion of Be salts and skin contact. Transportation of this metal through human tissue is accomplished via the bloodstream. Be is classified as a probable human carcinogen (Class B2), producing major adverse health effects to the lung and skeletal system. Human epidemiological studies indicate a possible relationship between inhalation of beryllium and the incidence of lung cancer in exposed workers. Animal studies have demonstrated the induction of tumors by a variety of beryllium compounds. An increase in lung cancer was observed in rats following both chronic oral and inhaled dosages of Be, with inhalation being the more dangerous route of exposure (i.e., producing a higher incidence of cancer at lower concentrations). Bone cancer has been induced in rabbits and mice following chronic intravenous injection of various Be salts.

The toxicity of Be is also evident by the noncarcinogenic health effects that exposure can produce. Skin contact may result in a delayed allergic reaction, which is characterized by large skin lesions that may not heal. Inhalation of beryllium causes inflammation of the entire respiratory tract and berylliosis (chronic lung disease). The estimated safe oral dosage (RfD) for lifetime exposure to Be is 5x10[-4] mg/kg/day.

5. Cadmium

Cadmium (Cd) is a noncorrosive metal used in a wide variety of industrial processes such as electroplating and galvanizing. It is also used as a color pigment for paints and plastics, and as cathode material for nickel-cadmium batteries. Cadmium is a by-product of zinc and lead mining, which are significant sources of environmental pollution. Cd is an airborne workplace contaminant, but exposure is of greater concern to the general population. It is found in food stuffs such as grains, meat, fish and fruit, in contaminated air, water, and soil, as well as in cigarette smoke. Humans are exposed to cadmium via inhalation and ingestion, at which time the metal can be transported through the bloodstream to vital organs. Cd is designated as probable human carcinogen (Class B1), based on a higher incidence of lung cancer in cadmium smelter workers, and increased incidence of prostrate cancer in battery workers. Several animal studies support this data. Chronic inhalation exposure of rats to cadmium produce lung tumors in Wistar rats, and tumors at various sites (including mammary tumors in females) in Fischer rats.

Acute exposure to high concentrations of Cd by ingestion causes nausea, vomiting, and abdominal pain; inhalation of fumes causes inflammation and edema (i.e., liquid accumulation) in the lungs. Progressive accumulation of Cd in soft tissues, particularly the kidney, poses a serious human health risk. A higher incidence of kidney damage reported for certain regions of Japan has been linked to a high intake of dietary cadmium. Chronic exposure in humans may also result in irreversible lung damage in the form of chronic bronchitis and emphysema. The estimated safe daily oral intake of Cd (RfD) which does not pose an appreciable risk to human health over a lifetime is 5x10[-4] mg/kg/day.

B. RISK ASSESSMENT

EPA's sampling of Site soils found that the average concentration of lead in surface soil samples was 6,720 milligrams per kilogram (mg/kg). The average settled lead dust concentration found in the brick house onsite was 9,203 mg/kg. The average lead concentration in the overburden and bedrock aquifers, both of which are drinking water sources was 0.00636 milligrams per liter (mg/l). In addition, EPA has recently identified a blood lead concentration of 10 micrograms per deciliter (ug/dl) as a level of concern for both children and adults. Using this average and current biological impact models, the EPA has estimated that 99.8% of the children residing onsite will have blood-lead above 10 ug/dl, with an average level of 46.96 ug/dl. The average bloodlead levels of adults residing onsite and adults working onsite are calculated to be 36.0 ug/dl and 13.9 ug/dl, respectively.

The shallow aquifer appears to be contaminated by lead, nickel, beryllium, cadmium, cobalt, copper, aluminum, manganese, zinc, iron, sulphate and acid. While elevated lead concentrations are found only in the are adjacent to the battery breaking building, depressed pH and elevated metals occur in the shallow aquifer under most of the Site. The lower pH is likely caused by direct dumping of sulfuric acid to the ground near the battery breaking building and possibly by the leaching of residual acid from battery casings that were deposited throughout the Site. Higher concentrations of other dissolved metals (aluminum, iron, manganese and zinc) in the shallow aquifer appear to be associated with the low pH.

The bedrock aquifer near the battery breaking building is contaminated by elevated levels of cadmium, beryllium, manganese. nickel, lead and high levels of sulfate. The bedrock ground water also has a pH below 5, which has caused concentrations above background of dissolved aluminum, calcium, chromium cobalt copper, iron, magnesium, silver, and zinc. Many of these metals may originate from leaching soils and aquifer solids by sulfuric acid dumped near the battery breaking building. The source of cadmium, however, may be attributed to the batteries broken and dumped on Site.

Potential risk was quantified for resident children and adults for ingestion and inhalation exposure to manganese, nickel, beryllium, and cadmium by integrating quantified exposure pathway intake values and contaminant toxicity values. Carcinogenic risk through drinking water was calculated only for beryllium due to unavailable toxicity values for other contaminants. The calculated carcinogenic risks for the resident child and adult are 6x10[-6] (6 additional cancer cases per million children exposed) and 4x10[-4] (4 additional cancer cases per 10,000 adults exposed), respectively. A Hazard Index (HI) value above 1.0 indicates that the potential exists for adverse noncarcinogenic health effects. The calculated HI for the resident child and adult as a result of ingestion of the manganese contaminated onsite ground water is 10, indicating a high potential for adverse effects. Based on the conclusions of this Risk Assessment, actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to the public health, welfare, or the environment.

The cleanup levels for ground water are the lower of Maximum Contaminant Levels (MCLs) or background water quality levels. For this Site, background water quality becomes the cleanup level for all contaminants except Manganese, which must be cleaned to the Commonwealth of Pennsylvania MCL of 50 ppb. Background levels for the shallow alluvial aquifer and the bedrock aquifer are preliminary and will be further refined during remedial design (see Tables 1 and 2). EPA is adopting a cleanup level for lead in soils of 1000 mg/kg. Under this cleanup level, the future use of the Site will be restricted to industrial use only. Present EPA policy is to use a range of 500 - 1000 mg/kg in residential areas to protect the health of young children. There is, however, no established criterion for a soil lead level to protect adult residents or adults who work, but do not live, on a site contaminated with lead. Calculations by EPA have shown that adult workers exposed to a soil lead concentration of between 682 mg/kg and 4082 mg/kg will result in a blood lead level of 10 ug/dl. EPA has, therefore, determined that 1000 mg/kg, the upper bound of the "residential" range, is also a reasonable cleanup level to protect the health of adult workers.

C. ENVIRONMENTAL ASSESSMENT

Lead is the most voluminous, widespread, and concentrated contaminant found onsite, and is therefore the most likely contaminant to affect onsite receptors. Small amounts of other metals, including manganese, zinc, and iron may affect nearby aquatic organisms due to migration of these metals in solution short distances from the Site.

RI sampling data indicate that contaminants have only migrated a few tens of feet from the Site generally in relatively low concentrations. Potential receptors are largely limited to organisms living onsite and in the Schuylkill River and Mill Creek immediately adjacent to the Site. Exceptions are predatory animals that may live nearby and feed on prey animals living onsite. No endangered species or critical habitats have been found to be associated with the Site or in the immediate area surrounding the Site.

Table 1
Applicable Cleanup Levels - Shallow Alluvial Aquifer
(Based on background dissolved concentrations unless otherwise noted)

CONTAMINANT	CLEANUP LEVEL	BACKGROUND	OBSERVED
Aluminum	32.6 ug/l	32.6 ug/l	4,600 ug/l
Cadmium	ND		ND
Lead	<3 ug/l	<3.0 ug/l	323 ug/l
Manganese	50 ug/l	25-183 ug/l	30,600 ug/l
pH	6.5-8.5	6.6-7.3	3.9-6.3
Silver	<10 ug/l	<10.0 ug/l	ND
Sulfate	54.5 mg/l	54.5 mg/l	1180 mg/l
Total Dis. Solids	140 mg/l	140.0 mg/l	1,400 mg/l
Zinc	<20 ug/l	<20.0 ug/l	240 ug/l
Iron	200 ug/l	200.0 ug/l	110,000 ug/l
Copper	<25 ug/l	<25.0 ug/l	ND

Table 2
Applicable Cleanup Levels - Bedrock Aquifer
(Based on background dissolved concentrations unless otherwise noted)

CONTAMINANT	CLEANUP LEVEL	BACKGROUND	OBSERVED CONCENTRATION[*]
Aluminum	50-200 ug/l	-85 ug/l	55,400 ug/l
Beryllium	0.19 ug/l	-0.19 ug/l	30 ug/l
Cadmium	0.88 ug/l	-0.88 ug/l	58 ug/l
Calcium	29 mg/l	29 mg/l	445 mg/l
Chromium	-2.3 ug/l	-2.3 ug/l	31,4 ug/l
Cobalt	-4.1 ug/l	-4.1 ug/l	2070 ug/l
Copper	25 ug/l	25 ug/l	180 ug/l
Iron	120 ug/l	120 ug/l	76,000 ug/l
Lead	<3 ug/l	<3 ug/l	14.5 ug/l
Magnesium	8.4 mg/l	8.4 mg/l	746 mg/l
Manganese	50 ug/l[**]	696 ug/l	263,000 ug/l
Nickel	-2.9 ug/l	-2.9 ug/l	1,440 ug/l
Potassium	1.59 mg/l	1.59 mg/l	11.3 mg/l
Silver	2.9 ug/l	2.9 ug/l	55 ug/l
Sodium	10.8 mg/l	10.8 mg/l	36 mg/l
Zinc	76 ug/l	76 ug/l	3600 ug/l
Sulfate	27 ug/l	27 ug/l	4910 ug/l

<Footnotes>
* Maximum level found
** Based on State MCL
</footnotes>

1. Bioassessment Testing on Schuylkill River Sediments

A whole sediment chronic bioassay test was performed based on the recommendation of the Region III EPA Bioassessment Group. Chironomous tentans (midge fly larva) was used for chronic sediment bioassay emergence studies conducted on the Schuylkill River sediment samples. Samples were collected from four locations on the river during Phase II sampling. These locations were chosen because of their fine-grained sediment texture and because of their location in depositional zones near the Site. In addition, Phase I sediment sampling results indicated that these locations represented a typical range of sediment lead concentrations.

The results of the tests, according to the toxicological evaluation, were as follows:

"No significant difference in emergence of midges could be detected between control and test sediments. Control emergence totaled 76 percent. Although sample BA4 had low emergence (61 percent), relative to the controls, there was high enough variability in the response to this sample to preclude significance... The fact that BA3 showed higher emergence than the controls indicates that this sample may contain better growth conditions than the control in terms of particle size or organic matter."

The most highly impacted organisms are probably burrowing animals living in contaminated soils onsite. Ingestion of contaminated soils can provide significant exposure to burrowing animals, including small rodents and lower forms such as worms and insects. Small herbivores may also be impacted by ingestion of contaminated plants. Many plant species absorb lead, and lead-bearing dust can also contaminate plants.

Predators feeding on burrowing animals can potentially be exposed; however, lead is not generally biomagnified. Bioconcentration factors tend to decrease as trophic levels increase.

The Schuylkill River is designated as a scenic river by the Commonwealth of Pennsylvania. It is considered appropriate for contact and noncontact recreation. RI data suggests water quality in the river downstream of the Site is not significantly impacted by contaminants from the Site.

Aquatic organisms living in the Schuylkill River and Mill Creek adjacent to the Site may potentially be affected by contaminants from the Site. Lead is expected to exist in the solid phase under conditions present in Site surface waters, adsorbing to sediments. Bioassays were performed on four sediment samples collected from the Schuylkill River adjacent to and immediately downstream of the Site. Results indicate no significant toxic effects from the sediments.

VII. SUMMARY OF REMEDIAL ALTERNATIVES

A. SOILS AND CASINGS

In order to select the most appropriate remedy for the Site, various alternatives are developed so that a variety of distinct, viable options can be analyzed. The costs for each alternative are based on the "Restricted site use" cleanup level which is 1000 mg/kg total lead in soil. The alternatives evaluated for the soils and battery casings include the following:

Alternative S1: No Action.

Alternative S2: Onsite Stabilization/Solidification of Soil and Casings, Offsite Disposal of the Treated Mass at a Permitted Landfill.

Alternative S3: Offsite Treatment/Disposal of Soil and Casings at a RCRA Hazardous Waste Landfill.

Alternative S4: Onsite Stabilization/Solidification of Soil Only, with Offsite Disposal of the Treated Mass at a Permitted Landfill; Thermal Treatment/Energy Recovery/Lead Recovery of Casings.

Alternative S5: Offsite Thermal Treatment of Soil and Casings.

It should be noted that all costs, time frames and volumes discussed below are estimates. All alternatives, except the No Action alternative, require excavation of only those contaminated materials (soils and casings) above the 1000 mg/kg cleanup level. Alternatives S2, S3, S4, and S5 will, therefore, include deed restrictions limiting the Site to industrial use only. 1. Alternative S1 - No Action. The NCP requires that the "no action" alternative be evaluated at every site to establish a baseline for comparison. Long-term environmental monitoring of nearby surface water and sediments (Mill Creek and Schuylkill River) and ambient air for heavy metals of concern would be conducted for 30 years. Monitoring would be performed quarterly for the first ten years, semiannually for the second ten years and annually for the last ten years. Under this alternative, contamination would remain onsite, and health risks to residents and workers would be high.

. Capital Cost: $0
. Long-term Monitoring (30 years)
  First 10 years: $32,000
  Second 10 years: $16,800
  Third 10 years: $ 8,820
. Present Worth: $296,350
. Time to Implement: 30 years

There are no ARARs associated with a no action alternative.

2. Alternative S2 - Onsite Stabilization/Solidification of Soil and Casings, Offsite Disposal of Stabilized Mass in a Permitted Landfill. Under this alternative, the entire volume of contaminated materials (soils and casings) present on the Site would be solidified/stabilized onsite and removed offsite to a landfill permitted to accept this type of waste. Through the process of solidification/ stabilization, lead is physically entrapped within the matrix of the solidification/stabilization agent and its mobility is reduced. Any lead posts or plates will be separated from the casings prior to treatment and shipped offsite for disposal, as hazardous waste, to a RCRA permitted facility.

. Capital Cost: $28,360,000

. Annual Cost: None

. Present Worth: $28,360,000

. Time to Implement: 18 to 24 Months

Compliance with ARARs
This alternative will comply with the applicable portions of the PADER Ground Water Quality Protection Strategy which prohibit continued ground water quality degradation, as the entire waste volume will be removed from the Site. This alternative also will comply with the requirement for treatment before disposal to meet Land Disposal Regulations (40 CFR Part 268). Solidified wastes are required to meet the Toxicity Characteristic Leaching Potential (TCLP) standards for lead in leachate (5.0 mg/L) in order

to be disposed of in a properly permitted landfill. Treatability studies indicate that solidified wastes easily pass the Extraction Potential Toxicity test (E P Tox), which, though not the proper procedure, produces results very similar to the TCLP test with regard to metals. Therefore, EPA has determined that the treated wastes will meet TCLP standards and will be able to be disposed of in compliance with the above regulations.

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

Determinations about the effectiveness of soil remediation at the site will be based on EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media.

Remedial action activities will comply with regulations governing flood prevention for treatment and storage facilities located within a 100-year floodplain (40 CFR Part 6, Appendix A, Executive Order 11988, 25 PA Code S269.22(b), and 25 PA Code Chapter 265.470(2)).

This alternative will comply with regulations for generation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C).

Plans for Site restoration will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (32 P.S. SS820.21, et seq., and 821.31 - 38).

The action will comply with the requirements of the National Historic Preservation Act (Chapters 106 and 110(f) and 36 CFR Part 800) and Archeological and Historic Preservation Act (16 USC S469a-1) by reviewing historical records and conducting a Site historical significance survey. If the results of these efforts indicate the Site has historic significance, additional archaeological work will be conducted to preserve any historical artifacts prior to commencement of the remedial action.

Onsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 - 264.603 (miscellaneous units).

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

This alternative will not comply with State regulations for closure of hazardous waste sites (25 PA Code S265.300 - 310), but these closure regulations will be waived based on achieving an Equivalent Standard of Performance by the removal of the contaminated soils and remediation of the ground water to background levels.

3. Alternative S3 - Offsite Treatment/Disposal of Soil and Casings at a RCRA Hazardous Waste Facility. This alternative consists of the excavation of the entire volume of contaminated soils and battery casings present on the Site and transportation (as a hazardous waste) to a RCRA facility for treatment and disposal.

- Capital Cost: $49,000,000
- Annual Costs: None
- Present Worth: $49,000,000
- Time to Implement: 18 to 24 Months

Compliance with ARARs

This alternative will comply with the applicable portions of the PADER Ground Water Quality Protection Strategy which prohibit continued ground water quality degradation, as the entire waste volume will be removed from the Site. This alternative also will comply with the requirement for treatment before disposal to meet Land Disposal Regulations (40 CFR Part 268). Solidified wastes are required to meet the Toxicity Characteristic Leaching Potential (TCLP) standards for lead in leachate (5.0 mg/L) in order to be disposed of in a properly permitted landfill. Treatability studies indicate that solidified wastes easily pass the Extraction Potential Toxicity test (E P Tox), which, though not the proper procedure, produces results very similar to the TCLP test with regard to metals. Therefore, EPA has determined that the treated wastes will meet TCLP standards and will be able to be disposed of in compliance with the above regulations.

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3. Determinations about the effectiveness of soil remediation at the site will be based on EPA 230/02-89 -042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media.

Remedial action activities will comply with regulations governing flood prevention for treatment and storage facilities located within a 100-year floodplain (40 CFR Part 6, Appendix A, Executive Order 11988, 25 PA Code S269.22(b) and 25 PA Code Chapter 265.470(2)).

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Offsite and onsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers) and Subchapter J (tanks).

Plans for Site restoration will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (32 P.S. SS820.21, et seq., and 821.31 - 38).

The action will comply with the requirements of the National Historic Preservation Act (Chapters 106 and 110(f) and 36 CFR Part 800) and Archeological and Historic Preservation Act (S16 USC 469a-1) by reviewing historical records and conducting a Site historical significance survey. If the results of these efforts indicate the Site has historic significance, additional archaeological work will be conducted to preserve any historical artifacts prior to commencement of the remedial action.

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility which is not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

This alternative will not comply with State regulations for closure of hazardous waste sites (25 PA Code S265.300 - 310), but these closure regulations will be waived based on achieving an Equivalent Standard of Performance by the removal of the contaminated soils and remediation of the ground water to background levels.

4. Alternative S4 - Onsite Stabilization/Solidification of Soil Only, Offsite Disposal of Stabilized Mass in a Permitted Landfill; Incineration of Casings with Subsequent Energy Recovery/Lead Recovery. Under this alternative, the same treatment process as described in Alternative S2 would be used for the contaminated soil; however, the casings would be separated and transported to a secondary lead smelter. An estimated 13,000 Btu's per pound can be recovered from the casings, and approximately 96% of the lead remaining in the casings can be recovered. The estimated volume of casings is 21,120 cubic yards. The smelting facility is subject to a RCRA permit for the treatment, storage and disposal of hazardous wastes and a Clean Air permit regulating air emissions. All current and future land disposal requirements for disposal of slag, baghouse dust, and air scrubber sludges apply.

- Capital Cost: $24,631,000

- Annual Cost: none

- Present Worth: $24,631,000

- Time to Implement: 36 to 42 Months

Compliance with ARARs

This alternative will comply with the applicable portions of the PADER Ground Water Quality Protection Strategy which prohibit continued ground water quality degradation, as the entire waste volume will be removed from the Site. This alternative also will comply with the requirement for treatment before disposal to meet Land Disposal Regulations (40 CFR Part 268). Solidified wastes are required to meet the Toxicity Characteristic Leaching Potential (TCLP) standards for lead in leachate (5.0 mg/L) in order to be disposed of in a properly permitted landfill. Treatability studies indicate that solidified wastes easily pass the Extraction Potential Toxicity test (E P Tox), which, though not the proper procedure, produces results very similar to the TCLP test with regard to metals. Therefore, the EPA has determined that the treated wastes will meet TCLP standards and will be able to be disposed of in compliance with the above regulations. This alternative also will comply with the preference for recycling of hazardous wastes stipulated by the NCP. The incineration of battery casings would be performed at a facility permitted under 25 PA Code Chapter 265, Subchapter R, and 25 PA Code Chapter 270, in accordance with 25 PA Code Chapter 264, Subchapter O, regarding incineration, and in accordance with the applicable provisions of 40 CFR Part 266, Subpart H, regarding the handling and processing of hazardous wastes in boilers and industrial furnaces. A long-term storage facility will need to be used to contain the contaminated battery casings pending processing. Casings will require storage for a period of approximately 3.5 years. The storage facility must be a RCRA permitted treatment, storage or disposal (TSD) facility.

Fugitive dust emissions generated at the site and at the secondary lead smelter during remedial activities will comply with fugitive dust regulations in the Federally approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3. In addition, the secondary lead smelting operation will comply with all applicable air emission requirements in accordance with 25 PA Code Chapter 123 and 25 PA Code Chapter 127, Subchapters C and D. Should modification to the secondary lead smelter become necessary to handle incineration of the battery casings, the applicable provisions of 25 PA Code Chapter 127, Subchapters A and B, would also apply.

Determinations about the effectiveness of soil remediation at the site will be based on EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media.

Remedial action activities will comply with regulations governing flood prevention for treatment and storage facilities located within a 100 year floodplain (40 CFR Part 6, Appendix A, Executive Order 11988, 25 PA Code S269.22(b), and 25 PA Code Chapter 265.470(2)).

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Plans for Site restoration will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (No. 32 P.S. Chapters 820.21 and 821.31 - 38).

The action will comply with the requirements of the National Historic Preservation Act (Chapters 106 and 110(f) and 36 CFR Part 800) and Archeological and Historic Preservation Act (16 USC S469a-1) by reviewing historical records and conducting a Site historical significance survey. If the results of these efforts indicate the Site has historic significance, additional archaeological work will be conducted to preserve any historical artifacts prior to commencement of the remedial action.

Offsite or onsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 - 264.603 (miscellaneous units).

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

This alternative will not comply with State regulations for closure of hazardous waste sites (25 PA Code S265.300 - 310), but these closure regulations will be waived based on achieving an Equivalent Standard of Performance by the removal of the contaminated soils and remediation of the ground water to background levels.

5. Alternative S5 - Offsite Thermal Treatment of Soils and Casings/Lead Recovery. Under this alternative, which was proposed by Exide/General Battery Corporation (Exide) during the comment period following the publication of EPA's Proposed Plan for this Site on January 8, 1992, Exide proposes to design and install a fuming/gasification furnace as part of its secondary lead smelting operations in Reading, Pennsylvania. Support facilities (including a RCRA permitted storage facility for soil and battery cases, material sizing equipment, and material handling equipment) will be installed as part of this alternative. The furnace will be tied into the existing secondary lead smelting process at the facility as a source of lead and energy.

During the operation of the fuming/gasification furnace, contaminants in the soil and battery casings will be purged from the materials as a metal fume and the battery casings gasified. The produced gas which is generated will be ducted to the two existing reverberatory furnaces at Exide's Reading, PA, facility to be used as fuel. If necessary, this fuel will be supplemented by the natural gas which is currently used. Fumed or vaporized metal in the gas stream will be subsequently recovered in the two existing reverberatory furnaces and existing control systems equipment. Recovered lead will be returned to the existing reverberatory furnaces for subsequent reclamation. Purged soil will be generated as a solid material.

The ash volume generated from the furnace is expected to be approximately 10% of the original battery case feed volume plus the total volume of the soil feed. It is anticipated that the resulting ash will contain extremely low levels of metals.

- Capital Cost: $11,000,000
- Annual Cost: unknown
- Present Worth: unknown
- Time to Implement: 24 months for removal of waste from Site
  6 years for completion of soil cleanup

There costs and time frames are preliminary estimates from Exide who has an expressed interest in developing this technology.

Compliance with ARARs

This alternative will comply with the applicable portions of the PADER Ground Water Quality Protection Strategy which prohibit continued ground water quality degradation, as the entire waste volume will be removed from the Site. This alternative also will comply with the requirement for treatment before disposal to meet Land Disposal Regulations (40 CFR Part 268) as the soils and casings will be thermally treated. The treated wastes must meet TCLP standards for lead in leachate (5.0 mg/L) in order to be disposed of in a properly permitted landfill. The thermal treatment would be performed at a facility permitted under 25 PA Code Chapter 265, Subchapter R, and 25 PA Code Chapter 270, and in accordance with the applicable provisions of 40 CFR Part 266, Subpart H, regarding the handling and processing of hazardous wastes in boilers and industrial furnaces.
Fugitive dust emissions generated at the site and at Exide's smelter during remedial activities will comply with fugitive dust regulations in the Federally approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3. In addition, Exide's secondary lead smelting operation will comply with all applicable air emission requirements in accordance with 25 PA Code SS123.11 - 13 (particulate matter emissions), 25 PA Code SS123.21 - 22 (Sulfur compound emissions), 25 PA Code S123.25 (monitoring requirements) and 25 PA Code Chapter 127, Subchapter D (Prevention of Significant Deterioration of Air Quality requirements related to Exide's Sulfur Dioxide emissions). Should modification to the secondary lead smelter become necessary to handle thermal treatment of the battery casings, the applicable provisions of 25 PA Code Chapter 127, Subchapters A and B, would also apply.

Determinations about the effectiveness of soil remediation at the site will be based on EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media.

Remedial action activities will comply with regulations governing flood prevention for treatment and storage facilities located within a 100 year floodplain (40 CFR Part 6, Appendix A, Executive Order 11988, 25 PA Code S269.22(b), and 25 PA Code Chapter 265.470(2)).

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter262, Subchapters A and C, and Chapter 263).

Plans for Site restoration will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (32 P.S. SS820.21, et seq., and 821.31 - 38).

The action will comply with the requirements of the National Historic Preservation Act (Chapters 106 and 110(f) and 36 CFR Part 800) and Archeological and Historic Preservation Act (16 USC S469a-1) by reviewing historical records and conducting a Site historical significance survey. If the results of these efforts indicate the Site has historic significance, additional archaeological work will be conducted to preserve any historical artifacts prior to commencement of the remedial action.

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

Onsite and offsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers) and Subchapter J (tanks), and 40 CFR SS264.601 -

264.603 (miscellaneous units).

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

This alternative will not comply with State regulations for closure of hazardous waste sites (25 PA Code S265.300 - 310), but these closure regulations will be waived based on achieving an Equivalent Standard of Performance by the removal of the contaminated soils and remediation of the ground water to background levels. B. Shallow Alluvial Aquifer

The alternatives evaluated for cleanup of the shallow alluvial aquifer include the following:

. Alternative A1 - No Action

. Alternative A2 - Vertical Limestone Barrier

. Alternative A3 - Soil Mixing

. Alternative A4 - Subsurface Drain/Offsite Treatment

. Alternative A5 - Subsurface Drain/Onsite Treatment and Discharge

1. Alternative A1 - No Action. This alternative includes monitoring of approximately six shallow monitoring wells for thirty years. Monitoring would be performed quarterly for the first ten years, semiannually for the second ten years, and annually for the last ten years. Ground water samples would be analyzed for lead, pH, specific conductance, and sulfate. Longterm reduction of contaminant concentration may occur over a period of approximately 15 to 30 years through discharge into the Schuylkill River and Mill Creek. Eventually all contaminants would be retained by soils and to a lesser extent, discharged to the adjacent surface water and deposited in river sediments.

. Capital Cost: $17,640
. Long-term Monitoring (30 yrs):
First 10 Years: $18,208/yr
Second 10 Years: $9,560/yr
Third 10 Years: $5,020/yr
. Present Worth: $171,000
. Time to Implement: 30 years

2. Alternative A2 - Vertical Limestone Barrier. This alternative includes the construction of two vertical limestone barriers to neutralize the low pH and immobilize lead (see Figure 6). The barriers, which would be connected together, would be placed upgradient (perpendicular to Schuylkill River) and downgradient (adjacent to the Schuylkill River and Mill Creek) of the contamination, and consist of permeable crushed limestone placed ina three-foot trench from grade to bedrock. Contaminated water passing through these barriers would rise in pH to about 8, effectively immobilizing the dissolved metals. Together, both barriers would neutralize acidic soils and water and effectively immobilize the dissolved metal contamination on the Site. Sulfate contamination would also be reduced by this alternative. In addition, two ground water recharge ponds would be constructed and maintained. One would be upgradient of the contamination and the other would be located between the vertical limestone barriers. These ponds would recharge the shallow alluvial aquifer, increasing the velocity of the contaminated ground water through the vertical limestone barrier. Water in the pond can be maintained at a constant head by pumping either from the Schuylkill River or the discharge from the bedrock aquifer treatment system. Because this is a passive treatment system it is estimated that long-term monitoring will be required for a period of at least 6 years to assure the ground water is effectively treated.

. Capital Cost: $612,500

. Annual Cost (6 yrs): $18,208/yr

. Present Worth: $704,000

. Time to Implement: 3 to 6 years

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9).

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j)

and 25 PA Code SS131.2 and 131.3. This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4).

3. Alternative A3 - Soil Mixing. This alternative involves insitu chemical stabilization of lead and neutralization of pH by mixing the contaminated soils and subsurface materials with lime from ground surface to bedrock above and below the ground water table. The system utilizes a crane mounted mixing head with large, approximately 8 foot diameter, augers. This alternative immobilizes the lead and increases the pH immediately which eliminates the need for long-term monitoring. This is a proven technology with readily available materials and equipment. See Figure 7 for the area estimates for soil mixing.

. Capital Cost: $8,667,600

. Long-term Monitoring (one sampling event in 5 years): $4,448

. Present Worth: $8,690,000

. Time to Implement: 0.5 to 1 year

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 - 264.100, specifically 25 PA CodeSS264.97(i) and 264.100(a)(9).

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding

Construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4).4.

Alternative A4 - Subsurface Drain/Offsite Treatment. Under this alternative, ground water would be collected by subsurface drains installed 12 to 15 feet below the surface through the entire length of the lead and pH contamination. A drain and trench system would extend 900 feet (see Figure 8). Water would be pumped from the drain into a holding tank and then transported offsite to a Public Owned Treatment Works (POTW). This alternative would remediate the contaminated ground water at the Site; however, the estimated time to implement this alternative is 2 to 8 years.

@ Capital Cost: $339,000

. Annual Cost: $362,400/yr

. Present Worth (8 year duration): $2,547,000

. Time to Implement: 2 to 8 years

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9).

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 SCFR 50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Onsite and offsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 - 264.603 (miscellaneous units).

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4)

This alternative will comply with waste water pretreatment regulations (40 CFR Part 403).

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

5. Alternative A5 - Subsurface Drain/Onsite Treatment. Under this alternative, ground water would be collected by subsurface drains as described in Alternative 4. The water would then be pumped to a wastewater treatment system constructed onsite for treatment of bedrock ground water (see Figure 8). The effluent from the treatment system would be discharged to the Schuylkill River. The sludge would be hauled to a POTW and meet pretreatment standards of the specific POTW selected. This alternative is contingent on the implementation of a bedrock aquifer treatment system. If a treatment system is not built for the bedrock aquifer, then a treatment plant would be needed under this alternative. Listed below are two costs; the first cost assumes a bedrock aquifer treatment system exists, and the second cost assumes a wastewater treatment plant (WWTP) must be funded under this alternative.

WWTP Exists

- Capital Cost: $339,000
- Annual Cost: $57,900/yr
- Present Worth (8 year duration): $647,900
- Time to Implement: 2 to 8 years

WWTP Needed

- Capital Cost: $413,600
- Annual Cost: $227,500/yr
- Present Worth (8 year duration): $1,655,000
- Time to Implement: 2 to 8 years

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 -

264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9).

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263). Onsite and offsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 264.603 (miscellaneous units).

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4)

This alternative will comply with waste water pretreatment regulations (40 CFR Part 403).

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

Any surface water discharge will comply with substantive requirements of the Clean Water Act NPDES discharge regulations (40 CFR SS122.41 122.50), the Pennsylvania NPDES regulations (25 PA Code S92.31), the Pennsylvania Wastewater Treatment Regulations (25 PA Code SS95.1 - 95.3), and the Pennsylvania Water Quality Standards (25 PA Code SS93.1 - 93.9).

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

C. Bedrock Aquifer

The depth of contamination in the bedrock aquifer is currently unknown. It has been found at depths of 40 feet and assumed to be no deeper than 100 feet. The alternatives evaluated for cleanup of the bedrock aquifer are listed as follows:

@ Alternative B1 - No Action with Long-term Monitoring

. Alternative B2 - Pump and Offsite Treatment

. Alternative B3 - Pump and Onsite Treatment and Disposal

Alternative B1 - No Action. This alternative involves long-term sampling and analysis from six bedrock wells to monitor the fate and transport of the contamination for 30 years. Bedrock water samples will be collected semiannually for sulfate, beryllium, cadmium, calcium, manganese, magnesium, zinc, lead and pH.

. Capital Cost: $71,300

. Annual Cost: $9,400/yr

. Present Worth (30 year duration): $171,000

. Time to Implement: 30 years

There are no ARARs for a no action alternative.

Alternative B2 - Pump and Offsite Treatment. Under this alternative the bedrock ground water would be pumped and transported to a POTW. Ten to twenty wells would be installed upgradient, downgradient and within the area of bedrock contamination to trace the extent and direction of contaminant movement. These wells will be converted to pumping wells for the remedial action. The estimated yield with this well system is 10,000 gallons per day for a well system 40 feet deep. A 25,000 gallon storage tank would be erected onsite for storage of pumped groundwater. This alternative is sensitive to local POTW availability and capacity, and sensitive to the depth of contamination which is currently unknown. Listed below are costs for 40-foot wells and for 100-foot wells. A contingency factor of 40% has been added in each alternative because information on the bedrock aquifer is limited.

20 Wells - 40 Foot Depth

- Capital Cost: $994,147
- Annual Cost: $4,700/yr
- Present Worth: $1,019,000
- Time to Implement: 1 year

20 Wells - 100 Foot Depth

- Capital Cost: $4,187,260
- Annual Cost: $4,700/yr
- Present Worth: $4,212,000
- Time to Implement: 1 year

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code S264.90 - 264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9). The exception to this is manganese, which will be reduced to the level specified by the Commonwealth of Pennsylvania's MCL, 25 PA Code S109.202, which is lower than the calculated background concentration.

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

Onsite activities will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers) and Subchapter J (tanks), and 40 CFR SS264.601 264.603 (miscellaneous units).

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2,20.4).

This alternative will comply with waste water pretreatment regulations (40 CFR Part 403).

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50).

This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

3. Alternative B - Pump, Onsite Treatment and Disposal. In this alternative, a treatment facility will be constructed onsite and connected to the recovery well system described in Alternative B2. The ground water will be treated by precipitation and ion exchange for pH, cadmium, sulfate, iron, manganese, calcium and other metals and dissolved solids. The effluent would be used to recharge the shallow alluvial aquifer as

described in Alternative A2, or discharged to the Schuylkill River or a combination of both. The effluent quality is expected to meet ambient water quality criteria for discharge to the Schuylkill River or recharge ponds. Sludge will be removed by tank truck and transported to a POTW. Because of the uncertainties associated with the bedrock flow and contaminant characteristics, a 40% contingency factor has been added to the final cost. As in Alternative B2, costs are given for a 40foot well system and for a 100 -foot system because the depth of contamination is presently unknown.

20 Wells - 40 Foot Depth

. Capital Cost: $303,250

. Annual Cost: $4,700

. Present Worth (6 year duration): $328,000

. Time to Implement: 1 year

20 Wells - 100 Foot Depth

. Capital Cost: $586,800

. Annual Cost: $4,700

. Present Worth (6 year duration): $612,000

. Time to Implement: 1 year

Compliance with ARARs

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9). The exception to this is manganese, which will be reduced to the level specified by the State MCL, 25 PA Code S109.202, which is lower than the calculated background concentration.

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3.

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Onsite treatment will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 264.603 (miscellaneous units).

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4)

This alternative will comply with waste water pretreatment regulations (40 CFR Part 403).

This Alternative will comply with the requirements for storage of wastes restricted from land disposal (40 CFR S268.50). This alternative will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

Any surface water discharge will comply with the substantive requirements of the Clean Water Act NPDES discharge regulations (40 CFR SS122.41122.50), the Pennsylvania NPDES regulations (25 PA Code S92.31), the Pennsylvania Wastewater Treatment Regulations (25 PA Code SS95.1 - 95.3), and the Pennsylvania Water Quality Standards (25 PA Code SS93.1 - 93.9).

VIII. COMPARATIVE ANALYSIS OF ALTERNATIVES

A. Overall Protection of Human Health and the Environment.

1. Soils

Alternatives S2, S3, S4 and S5 all provide adequate protection of human health and the environment since the lead-contaminated materials are processed, either onsite or offsite, and securely landfilled or treated, thereby eliminating all exposure pathways. The no action alternative (Alternative S1) provides no additional protection of human health and the environment since no mitigation of the current soil exposures is effected.

2. Shallow Ground Water

Alternatives A2, A3, A4 and A5 provide adequate protection of human health. Alternatives A2, A4, and A5 provide for protection of human health and the environment by immobilizing or removing the contaminants over time. Alternative A3 immediately protects human health and the environment by immobilizing the contaminants in the soil matrix. Alternative A1 fails to provide adequate protection of human health or the environment.

3. Bedrock Ground Water

Alternatives B2 and B provide adequate protection of human health and the environment because both alternatives completely remove the contamination from the bedrock aquifer. Alternative B1 fails to provide adequate protection of human health or the environment.

B. Compliance with ARARs.

1. Soils

Alternatives S2, S3, S4, and S5 will eliminate continued ground water quality degradation because the entire waste volume will be removed from the Site (PADER Ground Water Quality Protection Strategy). Alternative S1 is not in compliance with this waste disposal requirement. Ground water degradation would continue to occur if Alternative S1 were implemented.

Alternatives S2, S3, S4 and S5 are also in compliance with the regulatory requirement for treatment before disposal to meet LDRs (40 CFR Part 268) and with requirements for storage of waste restricted from Land Disposal (40 CFR S268.50). Solidified wastes in Alternatives S2, S3, and S4 as well as the ash in Alternatives S4 and S5 are required to meet TCLP standards for lead in leachate (5.0 mg/L) in order to be classified as non-hazardous and allow disposal in a Pennsylvania landfill that is permitted to accept residual (nonhazardous industrial) wastes. RCRA landfills also require compliance with leachate testing. Therefore, the hazardous wastes sent to the RCRA facility according to Alternative S3 will be treated to achieve the 5 mg/L TCLP standard for lead as determined through TCLP testing. Treatability studies indicate that solidified wastes easily pass the EP Tox test, which is very similar to the TCLP test with regard to metals. Therefore, EPA has determined that the stabilized/solidified wastes will meet TCLP standards. The soil remediation in Alternatives S2, S3, S4, and S5 can be evaluated in accordance with EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media. Alternative S1 does not provide any treatment of the hazardous materials present on the Site to mitigate contaminant migration.

All requirements for smelting and thermal treatment in Alternatives S4 and S5 will be met in accordance with applicable RCRA permits and requirements (40 CFR Part 266, Subpart H, 25 PA Code Chapter 265, Subchapter R, 25 PA Code Chapter 270). In addition, incineration in Alternative S4 will meet the requirements of 25 PA Code Chapter 264, Subchapter O.

Alternatives S2, S3, S4 and S5 comply with ARARs related to site fugitive dust controls during excavation and treatment and, for Alternatives S4 and S5, air emissions controls for incineration and thermal treatment equipment. (25 PA Code Chapters 121 - 142) that govern air emissions from remedial actions). These alternatives also comply with regulations governing flood prevention for treatment and storage facilities located within a 100 year floodplain (40 CFR Part 6, Appendix A, Executive Order 11988, 25 PA Code S269.22(b), and 25 PA Code Chapter 265.470(2)) through flood control measures and environmental monitoring. In Alternative S1, no wastes are excavated and no extensive airborne releases were predicted by the ISC model.

Alternatives S2, S3, S4, and S5 must comply with hazardous waste generation ARARs, and Alternatives S3, S4, and S5 must comply with transportation ARARs (i.e., metallic posts and plates, untreated wastes) according to 49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263.

Alternatives S3, S4, and S5 that employ onsite and offsite treatment, storage, and disposal of wastes will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks), and 40 CFR SS264.601 - 264.603 (miscellaneous units). Alternative S2 will comply with onsite treatment and storage requirements.

Plans for Site restoration for all four alternatives that include excavation will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (No. 32 P.S. SS820.21, et seq., and 821.31 - 38).

Alternatives S3 and S4 will comply with CERCLA S121(d)(3) and withEPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

Alternatives S2, S3, S4 and S5 will not comply with State ARARs for closure of hazardous waste sites, but will achieve an Equivalent Standard of Performance by removing the contaminated soils and remediating the ground water to background levels.

2. Shallow Ground Water

Alternative A1 does not comply with State or Federal MCLs or Pennsylvania regulations requiring cleanup to background levels. Alternatives A2, A4, and A5 do not immediately comply with the ARARs but require a number of years to achieve compliance. Alternative A3 would immediately comply with the ARARs for acid and dissolved metals.

In addition, Alternatives A4 and A5 would require storage and treatment facilities to be constructed within earthen berms or dikes to comply with the location specific floodplain ARAR. Alternative A5 would have to comply with the substantive requirements of an NDPES permit for surface water discharges, and Alternatives A4 and A5 would have to comply with land disposal restrictions and wastewater pretreatment requirements for wastes shipped to a POTW.

Alternatives A4 and A5, which include onsite and offsite treatment, storage, and disposal of wastes, will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers) and Subchapter J (tanks), and 40 CFR SS264.601 264.603 (miscellaneous units).

Alternative A4 and A5 will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Alternatives A4 and A5 will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

Alternatives A2, A3, A4 and A5 will comply with Pennsylvania Air Pollution Control Regulations (25 PA Code Chapters 121 - 142) that govern fugitive dust emissions during remedial actions.

Alternatives A2, A3, A4 and A5 will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4).

Alternatives A2, A3, A4, and A5 will comply with ground water monitoring requirements (25 PA Code Chapter 264, Subchapter F).

3. Bedrock Ground Water

Alternative A1 does not comply with State or Federal MCLs or Pennsylvania regulations requiring cleanup to background levels. Alternatives B2 and B would not immediately comply with the ARARs but require approximately a year to achieve compliance.

Alternatives B2 and B comply with the chemical specific ARARs. Alternative B2 will comply with the Clean Water Act as there will be no discharge to the Schuylkill River, while Alternative B must comply with substantive NPDES requirements for discharges to the Schuylkill River. Alternatives B2 and B would have to comply with land disposal restrictions and wastewater pretreatment requirements for wastes shipped to a POTW.

Alternatives B2 and B, which include onsite and offsite treatment, storage, and disposal of wastes, will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers) and Subchapter J (tanks), and 40 CFR 264.601 - 264.603 (miscellaneous units).

Alternatives B2 and B will comply with Pennsylvania Air Pollution Control Regulations (25 PA Code Chapters 121 - 142) that govern fugitive dust emissions during remedial actions.

Alternatives B2 and B will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4).

Alternatives B2 and B will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Alternatives B2 and B will comply with CERCLA S121(d)(3) and with EPA OSWER Directive #9834.11, both of which prohibit the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

Alternatives B2 and B will comply with ground water monitoring requirements (25 PA Code Chapter 264, Subchapter F).

C. Long-term Effectiveness and Permanence.

1. Soils

Each of the alternatives, with the exception of Alternative S1, would meet the criteria of long-term effectiveness and permanence. Alternatives S2, S3, S4, and S5 result in the lead contaminated soil and battery casings being removed from the Site resulting in a greatly reduced threat to the environment and an acceptable level of residual Site risks for onsite workers, but not residents. Since residential use will no longer be permitted, Alternatives S2, S3, S4 and S5 are all judged to be effective in the long-term.

Information collected through the stabilization/solidification treatability studies that were conducted for the RI/FS indicates the technology can permanently immobilize wastes. However, there are additional process and performance specifications that are not addressed in bench-scale studies. For example, the effectiveness of soil and casing separation needs to be determined for a large-scale operation as the separation in the treatability study was accomplished by hand sorting. In addition, Alternative S2 requires removal of the lead alloy from the battery casings prior to stabilization/solidification. The efficiency of this lead separation also needs to be determined. Alternative S5, which specifies thermal treatment, is judged to be more permanent than Alternatives S2, S3, or S4 as the contamination would be removed from the soils and the casings incinerated.

2. Shallow Ground Water

Alternatives A2, A3, A4, and A5 would result in minimal residual risk after the achievement of remedial objectives and are, therefore, judged to be effective in the long-term. Alternative A1 does not utilize remedial technologies and, therefore, has no long-term effectiveness other than that obtained by access restrictions. Alternatives A2, A3, A4, and A5 would all permanently remove the contamination from the shallow ground water.

3. Bedrock Ground Water

Alternatives B2 and B would both meet the criteria of long-term effectiveness and permanence since in both alternatives the contamination will be removed from the aquifer. Alternative B1 has limited long-term effectiveness because the plume is not expected to attenuate rapidly.

D. Reduction of Toxicity, Mobility or Volume Through Treatment.

1. Soils

The principal risk of exposure to lead contaminated soils addressed by each of the alternatives, with the exception of Alternative S1, is addressed in this analysis. Stabilization/ solidification fixes the waste in a solid matrix thereby greatly reducing leachability. The resulting reduction in mobility of lead contamination for Alternative S2, Alternative S3 and the soil portion of Alternative S4 is judged to be nearly 100 percent. In Alternative S5, the toxicity and mobility of the contaminants are greatly reduced as the lead is removed from the soil matrix and reused in the smelting process.

The resmelting of metallic lead posts and plates in Alternative S2 and Alternative S4 and the processing of the battery casings for energy recovery in Alternative S4 result in a reduction of the total volume of contaminated wastes. The volume reduction of Alternative S4 is estimated at 25%. This reduction includes the 14% increase expected as a result of the onsite stabilization/ solidification of Site soils. The reduction in volume of contaminated wastes resulting from recycling metal plates and posts in Alternative S2 is unknown because the volume of metallic plates and posts present in the containment area is not known. The reduction in volume of contaminated wastes resulting from Alternative S5 should be greater than that of Alternative S4 as there will be no stabilization/ solidification taking place.

For Alternative S2 there will be an increase in the volume of the contaminated waste due to the addition of a stabilization/ solidification agent. Treatment residuals result from each of the alternatives, except Alternative S1. These residuals consist of any contaminated debris that cannot be crushed or decontaminated for Alternative S2 and Alternative S4 and the scrubber sludge, baghouse dust and slag generated as a result of burning casings in Alternative S4 and the thermal treatment in Alternative S5. Since the baghouse dust and scrubber sludges are resmelted at the Reading facility, the risks from these residuals are judged to be equally low. Each of the treatment processes is irreversible since the lead is either bonded within a matrix or recycled.

Alternative S1, no action, does nothing to reduce the toxicity, mobility or volume of the lead-contaminated materials at the Brown's Battery Site.

2. Shallow Ground Water

Alternatives A2, A3, A4, and A5 remove or precipitate the contaminant out of the ground water thereby reducing the toxicity, mobility, and volume of the contaminant in groundwater. Alternative A1 will have a minimal impact on this criteria because it relies solely on natural attenuation.

3. Bedrock Ground Water

Alternatives B2 and B remove the contamination from the aquifer down to background levels thereby greatly reducing the toxicity, mobility and volume of the contaminants in the ground water. Alternative B1 will have a minimal impact on the toxicity, mobility and volume of the contamination because natural attenuation occurs slowly.

E. Short-term Effectiveness.

1. Soils

Short-term effectiveness considerations for the four alternatives including excavation of hazardous wastes are similar. Dust inhalation and release of lead-contaminated materials are judged to be the potentially serious risks from these alternatives. Wetting of the soil during processing or excavation should alleviate problems from dust inhalation by workers or release to the environment. Worker safety can also be addressed by the use of respiratory protection. Untreated soils and battery casings will be transported for Alternatives S3 and S5 and untreated casings will be transported in Alternative S4. These materials will be transported in trucks which are lined and covered and the wastes will be manifested according to Pennsylvania hazardous waste regulations and federal Department of Transportation requirements.

All alternatives, except Alternative S1, involve excavation of large portions of the Site, as well as temporary stockpiling of wastes onsite. Potential threats to the environment resulting from these actions include erosion of lead-contaminated soils and transport to Mill Creek and the Schuylkill River. In addition, since the Site is located on the floodplain of the Schuylkill River, flooding could cause a large-scale release of contaminants. These hazards are judged to be roughly the same for all alternatives except Alternative S1. Hazards can be mitigated through proper engineering controls.

If implemented, Alternative S2 and Alternative S4 would require the construction of processing areas on the Brown's Battery Site. Temporary environmental impacts would consist of the construction of concrete pads for processing areas, decontamination stations, and the installation of electrical utilities for the processing equipment. These structures should be easily removed at the end of the remedial actions. All of the onsite activities can be completed within 1 to 2 years of start-up, a relatively short period of time, which is a common advantage of each of the alternatives. Alternatives S4 and S5 also require the long-term storage of contaminated battery casings, however, this will be conducted offsite.

Alternative S1, the no action alternative, has no short-term effectiveness as the Site will remain contaminated and therefore continue to pose a risk to the public and to the environment.

2. Shallow Ground Water

Alternative A3 poses the greatest risk to workers from machinery and dust. Alternative A2, A4, and A5 pose equal risk to workers from machinery but less of a risk than Alternative A3. Alternative A1 would have the least risk involved for workers. All the Alternatives would pose limited risk to the community although more vehicular traffic would be expected for Alternative A4 because of daily offsite wastewater disposal.

Alternative A3 would achieve remedial action objectives immediately after completion of construction. Alternative A2, A4, and A5 would require a number of years to achieve remedial action objectives. It cannot be determined if Alternative A1 would ever achieve remedial action objectives.

The optimum time to implement Alternatives A2, A3, A4 or A5 is during soil remediation. These ground water alternatives should be installed after the contaminated soil is scraped off the upper few feet, but before clean backfill is compacted in place. This will minimize cost and avoid disturbance of the clean backfill once it is in place. With the exception of Alternative A1, each of the Alternatives involves excavation from grade to bedrock. As grade is lowered, the excavation is reduced. Moreover, there would be no concern for management and disposal of hazardous waste soils as these soils would be removed by the soil remediation. Alternatives A2 and A3 are earthwork intensive in situ technologies which are more conducive to being constructed during soil remediation than Alternatives A4 and A5. Alternatives A4 and A5 are less earthwork intensive and could occur after soil remediation with less impact on cost.

3. Bedrock Ground Water

Risks to the community and workers onsite are minimal for all three alternatives, although Alternatives B2 and B will have increased safety risks during construction related to drilling more wells and erecting equipment onsite. The duration of treatment and monitoring are the same for both Alternatives B2 and B, approximately one year for pumping, and 5 years for monitoring.

In Alternative 1, natural attenuation will be very slow and the fate of pollutants is unknown. Therefore, the aquifer will remain contaminated for an indefinite period of time.

F. Implementability

1. Soils

Implementability considerations for waste excavation and transportation varies only slightly among Alternatives S2, S3, S4, and S5. The required metal separation for Alternatives S2 and S4 and the soil and casing separation required for Alternative S4 pose minor additional implementability considerations. All Alternatives except Alternative S1 require hazardous waste transportation permits from the Commonwealth of Pennsylvania, the U.S. Department of Transportation and other states through which the waste may have to pass on its way to disposal. These permits should be readily obtainable. Several licensed hazardous waste transporters are available to transport the volume of wastes generated from these Alternatives. Availability of services is currently good for conducting Alternatives S2 and S3 and potentially poor for conducting Alternatives S4 and S5. The implementability of Alternative S4 is dependent upon the availability of one vendor to perform the resource recovery and waste recycling. Battery casings are currently being burned at this facility, but at low feed rates (~5 percent). In addition, there is significant question regarding the availability of storage capacity at this facility for the additional volume of battery casings expected from this Site.

The implementabilty of soil Alternative S5 is dependent upon several factors, both technical and administrative. The alternative combines two technologies which have been proven technically feasible in other industrial applications, but have never been used together in these circumstances. Pilot studies will be needed to demonstrate that these technologies can work together in this innovative fashion to clean the soils and gasify the battery casings while not interfering with the secondary smelting operations. Implementation of this alternative will require obtaining a RCRA permit as well as State and local permits for the long-term waste storage facility as well Federal, State and local permits for the new furnace. If these, or any other necessary permits cannot be obtained, or if the facility is in violation of RCRA regulations, this alternative cannot be implemented.

Alternative S1 can be readily implemented since environmental monitoring can be subcontracted from a large pool of available contractors.

2. Shallow Ground Water

Alternative A1 is the easiest to implement of all the alternatives. Little equipment and maintenance are required. Alternative A2 is more easily implemented than Alternatives A3, A4, or A5 and requires no maintenance. Alternative A3 requires a large mechanized operation to achieve its objectives, but would not require operation and maintenance. Alternatives A4 and A5 would both require the operation and maintenance of systems for several years. Alternative A4 requires a POTW for treatment and disposal of the extracted ground water. POTWs are available but have, in the past, refused to accept wastewaters from CERCLA sites. All of these alternatives are relatively easy to implement.

3. Bedrock Ground Water

Alternative B1 is more easily constructed than both Alternatives B2 and B, because fewer wells will be installed and less equipment erected. Alternative B2 is more easily constructed than Alternative B because less equipment is needed and operation and maintenance is less intensive.

Alternatives B2 and B have equally reliable technologies, and additional treatment would be relatively easy because the wells will be in place. Both alternatives have available offsite POTWs for disposal and treatment of residual waste. However, Alternative B2 relies solely on offsite POTWs for disposal, while Alternative B treats the ground water onsite and relies on offsite POTWs for disposal of residual waste only. Because the total volume to be treated is indefinite at this time, Alternative B is favored over Alternative B2 because available POTW capacity is finite. Technology considerations are not applicable to Alternative B1.

G. Cost

The estimated present worth costs are as follows:

1. Soils

Alternative 1 - $296,000
Alternative 2 - $28,360,000
Alternative 3 - $49,000,000
Alternative 4 - $24,631,000
Alternative 5 - $11,000,000*

2. Shallow Ground Water

Alternative 1	$171,000
Alternative 2	$704,000
Alternative 3	$8,690,000
Alternative 4	$2,547,000
Alternative 5	$1,655,000

3. Bedrock Ground Water

Alternative 1	$171,000	
Alternative 2	$1,019,000 (40 feet)	$4,212,000 (100 feet)
Alternative 3	$328,000 ..	$612,000 ..

* Exide/GBC cost estimate - not verified by EPA

Community Acceptance

The January 8, 1992, Proposed Plan and January 21, 1992, public meeting produced a small number of comments from the general public and a large volume of comments from Exide/GBC, the principal PRP, and its employees. Responses to these comments appear in the Responsiveness Summary section of this report.

The April 15, 1992, Revised Proposed Plan, which announced an opportunity for a public meeting, produced neither a request from the public for such a meeting, nor any comments on the Proposed Plan from the general public or the PRPs.

State Acceptance

The Commonwealth of Pennsylvania has not concurred on this ROD.

IX. SELECTED REMEDY

A. After careful consideration of the proposed remedial alternatives and evaluation against the nine criteria listed above, EPA has chosen a combination of alternatives as the Selected Remedy.

In the judgement of EPA, the following alternatives represent the best balance among the evaluation criteria and satisfy the statutory requirements of protectiveness, compliance with ARARs, cost effectiveness, and utilization of permanent solutions to the maximum extent practicable:

1. Soils and Casings

The selected alternative for soil remediation at the Brown's Battery Site is Alternative S5, Offsite Thermal Treatment of Soils and Casings. Specifically, EPA has determined that Alternative S5:

- Provides for maximum reduction in waste volume via thermal treatment of the casings, as opposed to Alternatives S2, S3, and S4 which would increase the volume of the waste due to the nature of the solidification/ stabilization process.

- Provides for maximum reduction in toxicity and mobility both at the Site, by excavation and removal of contaminated soils and casings, and at the ultimate location of the soil disposal, since the contaminants are removed from the soil medium, not merely stabilized within it. This also results in maximum protection of the offsite environment because the slight potential risk of the treated materials in Alternatives S2, S3 and S4 causing some future environmental harm at the disposal site is eliminated.

- Provides for maximum reuse/recycling of the metals after their removal from the soil matrix.

- Is the least costly of the soil alternatives.

EPA acknowledges that this alternative constitutes innovative technology for which no treatability or pilot studies have yet been completed. EPA believes, however, that the proposed combination of technologies which, individually, have been used in other industrial applications, has a reasonable expectation of being successful.

If, however, this innovative alternative cannot be implemented, EPA's preferred contingent alternative is S2, Stabilization/Solidification of Soil and Casings, Offsite Disposal of the Stabilized Mass in a Permitted Landfill. Specifically, EPA has determined that, among Alternatives S1, S2, S3 and S4, Alternative S2:

- Provides for maximum reduction in toxicity and mobility of the contaminated soils and casings.

- Can be implemented easily using available vendors.

- Is much less costly than other Alternatives considered to be as easily implementable.

- Does not require large volumes of hazardous waste to be transported over public roads.

EPA has determined that all of the following must take place in order for the selected Alternative, S5, to be considered technically and administratively feasible:

a. Exide/GBC must commit to implementing the primary alternative, S5.

b. Exide must submit a detailed expeditious schedule for the implementation of Alternative S5 which is acceptable to EPA. This schedule shall include, at a minimum, the major milestones to be accomplished during the remedial action that EPA will review when determining if the Alternative S5 continues to be implementable.

c. Pilot studies performed by Exide must demonstrate the technical feasibility of the process.

d. After any necessary pilot and treatability studies are completed, Alternative S5 must continue to provide the best balance among the nine criteria originally used to evaluate the alternatives.

e. Exide must obtain all legally required permits for the storage facility and for the construction and operation of the new furnace or other equipment related to Alternative S5.

2. Shallow Alluvial Aquifer

The selected alternative for the shallow alluvial aquifer is Alternative A2, Vertical Limestone Barrier. It is the least costly alternative other than Alternative A1, No Action. Alternative A2 is a passive treatment system which requires minimal operation and maintenance and immediately protects surrounding receptors. This alternative treats all shallow alluvial aquifer contamination and meets all Federal and Pennsylvania ARARs.

3. Deep Bedrock Aquifer

The selected alternative for the bedrock aquifer is Alternative B, Pumping and Onsite Treatment and Disposal with discharge to the recharge ponds described in Alternative A2 and/or the Schuylkill River. It is the least costly alternative, other than Alternative B1, No Action. Alternative B is a proven technology which is easily implementable. This alternative treats all the bedrock contamination and meets all Federal and Pennsylvania ARARs.

B. PERFORMANCE STANDARDS

1. Soils and Casings

Under Alternative S5, the entire volume of contaminated materials (soils and casings) present on the Site above 1000 mg/kg lead shall be excavated, removed offsite and treated by a thermal process to drive off the lead and other inorganics. Under the contingent Alternative, S2, the entire volume of contaminated materials (soils and casings) present on the Site above 1000 mg/kg lead shall be excavated, treated by a solidification/stabilization process and removed offsite to a landfill permitted to accept this type of waste.

Under either Alternative S5 or contingent Alternative S2, the treated waste must meet the LDR treatment standard (5 ppm for leachable lead) before its ultimate disposal, as well as the following:

The initial excavation phase will involve the excavation of the containment area (see Figure 2). Berms of sufficient height to protect against the 100-year flood will be constructed along the sides of the containment area to the railroad track embankment. These berms and the walls of the containment area will serve as protection against flooding. After excavation, the area will be backfilled with imported soil and the berms removed although the containment area mound will not be reconstructed.

Soil excavation will continue until all soils over the cleanup goal of 1000 mg/kg lead have been removed. Methods for determining that cleanup goals have been reached will be finalized during the design by EPA and but will be based on EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol I.

All vehicles transporting hazardous waste from the Site will be washed down before leaving the Site to minimize the spread of contamination to presently non-contaminated areas away from the Site.

All local roads damaged by the increased truck traffic due to the remedial action will be repaired following the conclusion of the onsite soil excavation.

2. Shallow Aquifer

Alternative A2 will remediate the ground water by increasing the pH in the shallow aquifer to between 6.0 and 8.0 and will achieve the background levels (Table 1) for the contaminants in the shallow ground water, which is a relevant and appropriate requirement under the PA Hazardous Waste Management Regulations. The Pennsylvania ARAR for hazardous substances in ground water is that all ground water must be remediated to "background" quality as specified by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and (j) and S264.100(a)(9). The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is also found in other legal authorities.

The limestone barriers, which would be connected together, would be placed upgradient (perpendicular to Schuylkill River) and downgradient (adjacent to the Schuylkill River and Mill Creek) of the contamination, and consist of permeable crushed limestone placed in a three-foot trench from grade to bedrock.

In order to remediate the shallow aquifer, two trenches shall be excavated down to bedrock. One trench shall be placed upgradient of the contaminated area, and run perpendicular to Schuylkill River. The other trench shall be placed downgradient of the contaminated area, perpendicular to the ground water flow direction and adjacent to the Schuylkill River and Mill Creek. These trenches shall connect with each other, enclosing the contaminated groundwater on three sides (see Figure 4). The trenches shall be backfilled up to the high water table with crushed limestone of an average particle diameter of 0.08 inches. Excavated soils shall be backfilled or sent offsite for treatment depending on whether they are above or below the selected cleanup level.

To decrease the time for all aquifer water to be treated by the limestone barrier, two infiltration ponds shall be constructed onsite. One shall be upgradient of the contamination and the other shall be located between the vertical limestone barriers. These ponds shall recharge the shallow alluvial aquifer, increasing the velocity of the contaminated ground water through the vertical limestone barrier. The recharged ponds shall be maintained at a constant, piezometric head by pumping water from the Schuylkill River and/or discharge from a bedrock aquifer treatment system.

Monitoring wells shall be installed in the area of contamination and sampled on a quarterly basis for at least 6 years. The number and location of these wells shall be specified by EPA during the design of the limestone barrier. If, at any time, sampling confirms that background levels have been attained throughout the shallow aquifer and remain at the required levels for twelve consecutive quarters, monitoring may be suspended.

3. Bedrock Aquifer

A treatment facility shall be constructed onsite and connected to the recovery well system described below. The ground water shall be treated for cadmium, sulfate, iron, manganese, calcium and other dissolved solid ions, and then discharged to the Schuylkill River. During design, wells shall be installed near the battery breaking building and monitoring well MW-13. Ten to twenty wells shall be installed in the suspected area of bedrock ground water contamination, that is, in the area where concentrations of contaminants in the ground water is suspected to be greater than the "background"limits specified in Table 2. These wells shall be used to determine the areal and vertical extent of contamination, and to determine aquifer parameters needed for flow rate and volume calculations. These wells shall be converted to pumping wells for the remedial action.

The Selected Remedy shall achieve the background levels (Table 2) for the contaminants in the bedrock ground water, which is a relevant and appropriate requirement under the PA Hazardous Waste Management Regulations. With the sole exception of manganese, the Pennsylvania ARAR for hazardous substances in ground water at this Site is that all ground water must be remediated to "background" quality as specified by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and (j) and 264.100(a)(9). The Commonwealth of Pennsylvania also maintains that the requirement to remediate to background is also found in other legal authorities. For manganese, the Pennsylvania ARAR is the State MCL (50 ug/L) specified by 25 PA Code S109.202, which, in this instance, is lower than the calculated background concentration.

In order to remediate the bedrock ground water, the extraction/treatment system implemented under this Selected Remedy shall operate until ground water monitoring shows that the concentrations of contaminants of concern have been reduced to the levels specified in Table 2. To this end, monitoring wells shall be installed in the area of contamination and sampled on a quarterly basis for at least 10 years. The number and location of these wells will be specified in the design of the extraction system. If sampling confirms that cleanup levels have been attained throughout the downgradient area and remain at the required levels for twelve consecutive quarters, operation of the extraction system can be suspended. If, subsequent to the extraction system shutdown, quarterly monitoring shows the ground water concentrations of any contaminant of concern to be above the levels specified in Table 2, the extraction system shall be immediately restarted and continued until the levels in Table 2 have once more been attained for twelve consecutive quarters.

All extracted ground water will be treated to levels which will allow for discharge into a nearby surface water body in compliance with the requirements of State and Federal NPDES regulations.

4. Ground Water

If implementation of the Selected Remedy demonstrates, in corroboration with hydrogeological and chemical evidence, that it will not be possible to meet the remediation standards and it is thus technically impracticable to achieve and maintain background concentrations throughout either the shallow or bedrock aquifer (or for manganese in the bedrock aquifer, achieve and maintain the State MCL), then EPA, in consultation with the Commonwealth of Pennsylvania, may amend the ROD or issue an Explanation of Significant Differences to inform the public of alternative ground water standards which may include, but not be limited to, any of the following:

a) engineering controls such as physical barriers, or long-term gradient control provided by low level pumping, as containment measures;

b) chemical-specific ARARs will be waived for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further contaminant reduction;

c) institutional controls will be provided/maintained to restrict access to those portions of the aquifer which remain above remediation goals;

d) continued monitoring of specified wells; and

e) periodic reevaluation of remedial technologies for ground water restoration.

The decision to invoke any or all of these measures may be made by EPA in consultation with PADER during a periodic review of the remedial action which occurs at least every five years, in accordance with Section 121(c) of CERCLA, 42 U.S.C. S9621(c).

C. DEED RESTRICTIONS

Restrictions shall be placed on the deeds to the properties that comprise the Site which shall limit the Site to "industrial use" only.

XI. STATUTORY DETERMINATIONS

Protection of Human Health and the Environment

Both the selected remedial action and the contingent alternative protect human health and the environment by treating highly contaminated soils and ground water. Under the selected remedy, soils that are above the cleanup level will be excavated, removed offsite and treated by a thermal process that will cause the lead and other inorganic materials to leave the soils as a fume or vapor and gasify the casings. Under the contingent alternative, the same soils would be treated by a stabilization/solidification process that will render them non-hazardous. In either case, the treated soils will be disposed of in accordance with Federal and State regulations. Shallow ground water will be treated in situ as it flows through a limestone gravel barrier. The limestone will raise the pH of the shallow aquifer, precipitating out the lead and rendering it immobile. The deep (bedrock) ground water will be extracted, treated to remove the lead and other inorganics, and discharged either to local streams or to the onsite retaining ponds.

Compliance with Applicable or Relevant and Appropriate Requirements

These standards are considered applicable to this action:

This action will comply with the requirements for treatment before disposal to meet Land Disposal Regulations and for storage of wastes banned from land disposal (40 CFR Part 268).

Fugitive dust emissions generated during remedial activities will comply with fugitive dust regulations in the Federally-approved State Implementation Plan for the Commonwealth of Pennsylvania, 40 CFR Part 52, Subpart NN, SS52.2020 - 52.2023 and in 25 PA Code SS123.1 and 123.2, and will cause no violation of National Ambient Air Quality Standards due to fugitive dust generated during construction activities, 40 CFR S50.6 and 40 CFR S52.21(j) and 25 PA Code SS131.2 and 131.3. In addition, the secondary lead smelting operation will comply with all applicable air emission requirements in accordance with 25 PA Code SS123.11 - 13 (particulate matter emissions), 25 PA Code SS123.21 - 22 (Sulfur compound emissions), 25 PA Code S123.25 (monitoring requirements) and 25 PA Code Chapter 127, Subchapter D (Prevention of Significant Deterioration of Air Quality requirements related to Exide's Sulfur Dioxide emissions). Should modification to the secondary lead smelter become necessary to handle thermal treatment of the battery casings, the applicable provisions of 25 PA Code Chapter 127, Subchapters A and B, would also apply.

Offsite treatment, storage, and disposal will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks).

This alternative will comply with regulations for generation and transportation of hazardous wastes (49 CFR Parts 171 - 173 and 25 PA Code Chapter 262, Subchapters A and C, and Chapter 263).

Remedial action activities will comply with regulations governing flood prevention for treatment and storage facilities located within a 100 year floodplain (25 PA Code S269.22(b) and 25 PA Code S265.470(2)).

Any surface water discharge will comply with the substantive requirements of the Clean Water Act NPDES discharge regulations (40 CFR SS122.41 122.50), the Pennsylvania NPDES regulations (25 PA Code S92.31), the Pennsylvania Wastewater Treatment Regulations (25 PA Code SS95.1 - 95.3), and the Pennsylvania Water Quality Standards (25 PA Code SS93.1 - 93.9).

The action will comply with the requirements of the National Historic Preservation Act (Chapters 106 and 110(f) and 36 CFR Part 800) and Archeological and Historic Preservation Act (16 USC 469a-1) by reviewing historical records and conducting a Site historical significance survey. If the results of these efforts indicate the Site has historic significance, additional archaeological work will be conducted to preserve any historical artifacts prior to commencement of the remedial action.

The offsite thermal treatment will be performed in accordance with the applicable provisions of 40 CFR part 266, Subpart H, regarding the handling and processing of hazardous wastes in boilers and industrial furnaces. The offsite thermal treatment will be performed at a facility permitted under 25 PA Code Chapter 265, Subchapter R, and 25 PA Code Chapter 270.

This alternative will comply with CERCLA 121(d)(3) which prohibits the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements.

This alternative will comply with waste water pretreatment regulations (40 CFR Part 403).

This alternative will not comply with State regulations for closure of hazardous waste sites (25 PA Code S265.300 - 310), but these closure regulations will be waived based on achieving an Equivalent Standard of Performance by the removal of the contaminated soils and remediation of the ground water to background levels.

This alternative will comply with the Delaware River Basin Commission Ground Water Protected Area Regulations regarding construction of water extraction wells (No. (6)(f); Water Code of the Basin, Section 2.50.2), metering of surface water intakes (No. 9; Water Code of the Basin, Section 2.50.2), non-interference with domestic or other existing wells (No. 10) and non-impact on ground water levels, ground water storage capacity, or low flows of perennial streams (No. 4; Water Code of the Basin, Section 2.20.4).

These standards are considered relevant and appropriate to this action:

Onsite treatment will comply with RCRA regulations and standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, in accordance with 25 PA Code Chapter 264, Subchapters A-E, Subchapter I (containers), and Subchapter J (tanks).

This alternative will comply with 25 PA Code Chapter 264, Subchapter F, regarding ground water monitoring.

Contamination in the ground water will be reduced to background levels as required by 25 PA Code SS264.90 - 264.100, specifically 25 PA Code SS264.97(i) and 264.100(a)(9). The exception to this is manganese, which will be reduced to the level specified by 25 PA Code S109.202 which is lower than the calculated background concentration. If implementation of the Selected Remedy demonstrates, in corroboration with hydrogeological and chemical evidence, that it will not be possible to meet the remediation goals and it is thus technically impracticable to achieve and maintain background concentrations throughout either the shallow or bedrock aquifer (or for manganese in the bedrock aquifer, to achieve and maintain the State MCL) then EPA, in consultation with the Commonwealth of Pennsylvania, may amend the ROD or issue an Explanation of Significant Differences to inform the public of alternative ground water goals.

The following are to be considered during this action:

This alternative will comply with EPA OSWER Directive #9834.11 which prohibits the disposal of Superfund Site waste at a facility not in compliance with S3004 and S3005 of RCRA and all applicable State requirements. Determinations about the effectiveness of soil remediation at the site will be based on EPA 230/02-89-042, Methods for Evaluating Cleanup Standards, Vol. I: Soils and Solid Media.

Continued ground water quality degradation will be prevented as called for in the PADER Ground water Quality Protection Strategy, December 1989.

Plans for Site restoration will comply with recommendations outlined in the Pennsylvania Scenic Rivers Act and Schuylkill River Scenic River Act (No. 32 P.S. SS820.21, et seq., and 821.31 - 38).

Onsite and offsite treatment will comply with RCRA regulations for owners and operators of treatment, storage, and disposal facilities, in accordance with 40 CFR SS264.601 - 264.603 (miscellaneous units).

This alternative will comply with 40 CFR Part 6, Appendix A, and Executive Order 11988 regarding actions to avoid adverse impacts on floodplains.

Cost Effectiveness

Cost effectiveness is determined by comparing the costs of the alternatives being considered with their overall effectiveness to determine whether costs are proportional to the effectiveness achieved. The estimated present worth cost of the Selected Remedy is $12,316,000. This Remedy is judged to afford overall effectiveness proportional to its cost such that the remedy represents good value for the money. When the relationship between cost and overall effectiveness of the Selected Remedy is compared to the cost and overall effectiveness of the of other combinations of the Alternatives that were considered, the Selected Remedy is judged the more cost effective. The estimated cost of the contingent alternative is $28,360,000. Should implementation of the soil component of the Selected Remedy prove to be infeasible, the relationship between cost and overall effectiveness of the contingent alternative, along with the selected ground water alternatives is judged the more cost effective in comparison to the cost and overall effectiveness of the other combinations of the Alternatives.

Utilization of Permanent Solutions and Alternative Treatment Technologies to The Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be utilized while providing the best balance among the other evaluation criteria. Should implementation of the soil component of the Selected Remedy prove to be infeasible, EPA has determined that, among the remaining alternatives, the contingent soil alternative along with the selected ground water alternatives represent the maximum extent to which permanent solutions and alternative treatment technologies can be utilized while providing the best balance among the other evaluation criteria. In addition, the thermal treatment process and the vertical limestone barrier are considered to be innovative methods for treating soils and ground water contaminated with lead and other inorganics.

Preference for Treatment as a Principal Element

The Selected Remedy satisfies the statutory preference for remedies that employ treatment as a principal element to permanently reduce the volume, toxicity, or mobility of hazardous substances. By excavating contaminated soils and removing the contamination and by extracting ground water from the aquifer and removing contamination from it before it is discharged back into the environment, the Selected Remedy addresses the primary risk posed by the Site through treatment. The contingent alternative would also reduce the toxicity and mobility of the contamination and address the primary risk through treatment as the contaminated soils and casings would be solidified/stabilized and disposed of in a permitted facility offsite.